ILLUSTRATED
ELECTRICAL REVIEW
A Journal of Scientific and Electrical Progress.

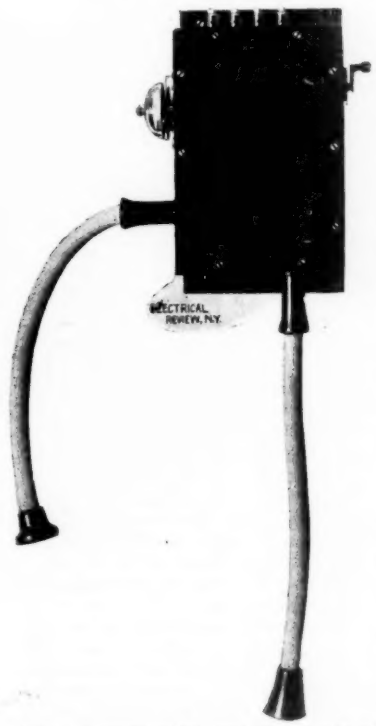
VOL. 25. No. 24. WEEKLY. NEW YORK, WEDNESDAY, DECEMBER 12, 1894. $3 per Annum. Single Copies, 10 Cents.

Copyright, 1894, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

"My boy once had a pet alligator that was pretty fierce," observed Meekin, the lazy inventor. "When he teased this young saurian, the beast would swipe out with its powerful tail in an amazing fashion, without doing itself or anybody else any good. It occurred to me that here was a splendid example of wasted energy and I set out to devise a means of conserving it and turning it to some useful purpose. I spent a Winter in Florida, and after I had experimented with some of the small 'gators that are supplied to tourists for a consideration, I ordered some big fellows. After some little trouble I secured 10 'gators, each about four feet in length and of about 10 horse-power tail capacity. My scheme for utilizing their tail-power—yes, it was a kind of a 'tail race'—was this: The 'gators were placed side by side in stalls which left their tails free to wag. I had upright beams set like pendulums, the swinging ends of the beams coming close enough to the 'gators' tails to be in a good position for action. Then I built a tank over the stalls and filled it with thundering big cannon balls. There was an inclined chute running from the tank to a power wheel made with hollow places in the rim, something like a water wheel. In the chute I had a valve to regulate the flow of cannon balls. Half the 'gators were used to work the cannon ball part of the machine and the other half to run a conveyor contrivance to lift the balls back into the tank after they had done their work in turning the wheel. I connected a small dynamo by a belt to a pulley wheel on the power wheel shaft. My main circuit ran from the dynamo to a bank of incandescent lamps which were to be used in the test. When everything was ready, the wheels oiled up, main switch closed and the 'gators pretty mad, I hired four little colored boys to go along in front of the stalls and crack the 'gators on the head with short clubs. This made 'em awful mad and so they struck out with their tails. Then the old shebang commenced to run. A little coon would hit a 'gator on the head, he'd let out with his tail, strike a beam, open the valve, let out a cannon ball, which rolled down the chute and onto the wheel turning it around. Then the ball rolled back to the conveyor and was hoisted up by one of the other 'gators. She was humming beautifully, but I had forgotten one thing; that was a governor. The little coons liked their work and lambasted the 'gators unmercifully. I stopped 'em, but the wild animals were beyond control. They lashed around until the speed got so high that the armature of the dynamo burned out with a flash. The 'gators running the conveyor got into a race with the other fellows and hoisted up cannon balls so fast that the tank got overweighted and broke down. The cannon balls fell on the 'gators' heads and killed every one of 'em. Fact, I assure you."



FIGS. 1 AND 2.—AMERICAN BELL TELEPHONE COMPANY'S MINING TELEPHONE SETS.

At Sandy Hook, N. J., on December 3, a successful test was made of the Gordon disappearing carriage for a 10 inch rifle. The carriage is worked by electric motors, one for pumping air and the other for the movement of the carriage. Thirty-two shots were fired inside of one hour. The contract called for the firing of 10 shots in an hour, and a bonus of $2,000 a shot was to be paid for each shot beyond 10. The designer and builders get a bonus of $44,000.

The death is announced at the age of 95, of Mr. Robert Davidson, of Aberdeen, Scotland. He is credited with having constructed a storage battery locomotive as long ago as 1839, which was tested on the Edinburgh and Glasgow Railway.

The American Bell Telephone Company's Mining Telephone Set.

The difficulties which have been experienced in obtaining telephone apparatus for use in mines consist in the corrosive action which takes place on all exposed metal parts, due to the dampness and to the gases which are prevalent. There is also in many mines dust which acts to clod and interfere with the successful operation of all moving parts.

The telephone set, which has been devised by the American Bell Telephone Company for mining purposes, is made in such a way that as few metal parts are exposed as possible, and of a material which prevents deposition of moisture upon the working parts. It has been found that for a set to be used in a mine wood is the best material that can be used. The wood is creosoted and thoroughly covered by a waterproof paint. As far as possible all joints are dovetailed, and such as are not dovetailed are made by the use of suitable packing.

As it is necessary to have the gongs for the bells on the outside of the box as well as the handle for the generator, the generator crank and the hammer of the bell enter the box through water-tight glands. The transmitter and receiver are placed within the box and are connected with the outside by means of long, flexible tubes, the interiors of which are of metal. By the use of these tubes it has been found that the moisture is condensed upon the sides of the tube and little or none upon the diaphragm of the receiver. The result is that the iron diaphragm of the receiver, which, under ordinary conditions, would last but a few weeks, has been made to last several years.

The magnetograph at Paris is reported to have recorded the recent earthquake at Constantinople 12 minutes after the shock, the distance covered being 3,000 kilometers, or about 1,800 miles. The oscillation must, therefore, have traversed Europe from east to west at the rate of 150 miles per minute.

DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

A LECTURE DELIVERED BEFORE THE NEW YORK ELECTRICAL SOCIETY NOVEMBER 27, 1894, BY GANO S. DUNN.

I wish to refer to-night to several features of direct current motor and generator design, and not to pretend to cover the whole subject, and I

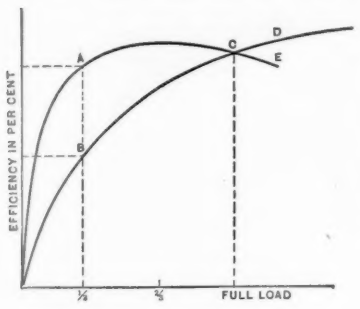


FIG. 1.

trust this will not be without interest to you.

The first point I wish to bring out is how very imperfect are our means of rating electrical machinery. We have good means of rating other machinery, but we do not have good means of rating electrical machinery. The steam engine is rated by the diameter of its cylinder and length of stroke and its speed. It is not sold by horse-power, because an engine which could develop 100 horse-power at three-tenths cut-off would develop 200 horse-power at six-tenths cut-off. In electricity the problem is similar, but we have no way of rating motors by the diameter of cylinder and length of stroke as they have in steam engine practice, and we are continually suffering on this account. Water wheels are not sold by horse-power. You do not buy a 50 horse-power water wheel; you buy a 28 inch water wheel and run it at so many feet head, and then figure out how much power you can get from it, and if it is not enough, you buy a 30 inch wheel.

The limits of loading an electric motor are really two only; namely, you have reached the load of a motor when it begins to heat so much that it is dangerous to continue to run it, and you have also reached its limit of load when it sparks so badly that if you run it longer it will destroy its commutator. There are builders to-day who build a motor which will have a very high efficiency at one-third load, but which will spark if it is overloaded, and there are other makers who build a machine which has not a high efficiency at light loads, but which will stand three and four times normal load without sparking. Now both of those motors are listed in the catalogues, are charged for and are known as, let us say, 10 horse-power motors.

If you buy a 10 horse-power motor without knowing something about these facts, it is possible that you will be very much mistaken. If it is agreed that we should call a motor that runs at about a six horse-power, but is capable of running at 10 horse-power continuously without dangerous overheating, but will never be called upon for more than 10 horse-power—if we should agree to call such a motor a 10 horse-power motor, very well. But then we ought to call the motor which is used in crane service, which is called upon for 30 or 40 horse-power for periods of 10 minutes at intervals, something more than, or different from, 10 horse-power, and the builder ought not to be obliged to make one motor fill one user's requirements and another user's requirements, when their requirements differ so much. Suppose we sell two 10 horse-power motors to ordinary customers. We may hear a report from one of them that this motor is not a good motor; it does not give 85 per cent efficiency at one-third load. While the other one will say this motor is not a good motor; it sparks very badly when loaded to 300 per cent of its normal load for a few moments. In view of these facts horse-power is not a fair way to rate machines.

The lines between these kinds of motors are not so distinctly drawn as I have pointed out, but for the purposes of illustration I have shown here two curves, A and B, Fig. 1. A is the curve of a motor of the kind first mentioned above. It is expected to run at six horse-power average, can give 10 horse-power all day long if you require it, but must not give any more, and has a very high efficiency at light loads. Such a motor is an ordinary power motor for running a printing or machine shop. The other motor, whose curve is shown at B, is a motor whose efficiency at light loads is very low; it is not much more than half of the former. But its efficiency at full load is exactly equal, and at overload is even higher than this other motor. Motor B is much superior for its work to the former motor because whenever it does run it runs at three times its rated load, and motor A, whenever it runs, as I will show later, runs at only one-third its rated load. Put motor B on the load that A is built for, and A on the load that B is built for, which is what you are likely to do, and you will not secure the best results.

This A curve machine is the type of ordinary power motor running machinery by a belt. The B curve machine is a type of railway motor or motor for operating cranes, or for other intermittent and very heavy work. These two conditions affect the design of a motor very much and the way they affect it is this: At the point C both motors have the same efficiency. That means that the losses in both motors are equal. But why, then, does curve A differ from B? The difference is in the distribution of the losses. The losses in a motor are of two kinds, fixed and variable. The fixed losses are the losses due to field current, hysteresis and eddy currents, brush friction and bearing friction. The variable losses are the losses due to armature resistance and the losses due to commutation. Now motor A is a machine with a small magnetic circuit, using comparatively few lines of force. Therefore, the wire that is wound around this magnetic circuit to keep it excited need not be very great and, therefore, will take but a small amount of current to energize it. The iron in the armature will be small in quantity, and, therefore, the hysteresis and eddy currents will be low, and the bearings will be rather light because this motor is never called upon for more than rated load. Therefore, the fixed losses are light. The variable losses, such as armature resistance and commutation losses, may be high in this machine without detriment. The reverse of these conditions is true in machine B. These points are of great importance but they have not received attention.

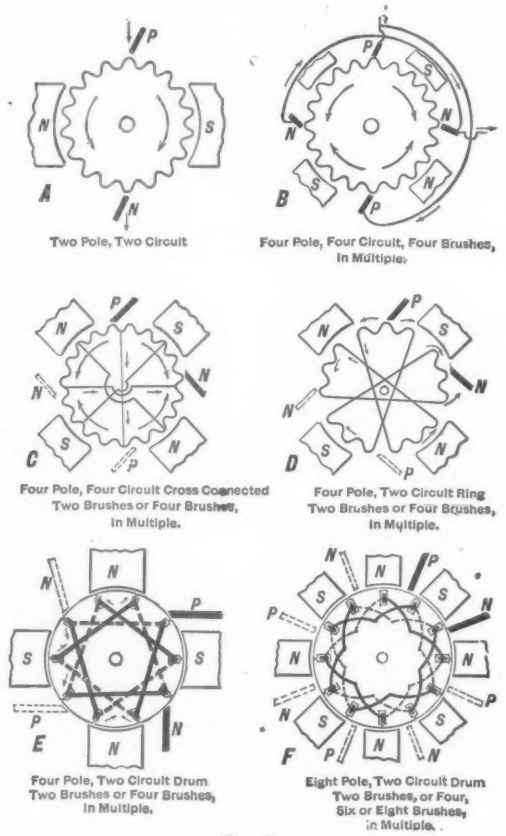

Two Pole, Two Circuit
Four Pole, Four Circuit, Four Brushes, In Multiple.
Four Pole, Four Circuit Cross Coanected Two Brushes or Four Brushes, In Multiple.
Four Pole, Two Circuit Ring Two Brushes or Four Brushes, In Multiple.
Four Pole, Two Circuit Drum Two Brushes or Four Brushes, In Multiple.
Eight Pole, Two Circuit Drum Two Brushes, or Four, Six or Eight Brushes, in Multiple.

FIG. 2.

As a result of tests made on about 200 power motors, at the instance of Mr. H. L. Lufkin of the Crocker-Wheeler Company, it was found that these 200 motors on actual commercial circuits did not average one-third of their load. The readings were taken in this manner. It is customary wherever a motor is installed to put a meter that measures the current taken. Now if this was a 10 horse-power motor and ran 10 hours per day, it ought to have 100 horse-power hours for every day it runs. The meter readings were taken and the average was between 25 and 30 per cent of the power that the motor could have given, according to what was stamped on its name plate. Now if we build a motor with the kind of efficiency curve B, and use it for a purpose such as I have just spoken of, where a motor averages only one-third load, it is practically equivalent to taking a motor of only one-half the efficiency.

Another thing with regard to the rating of motors is the speed. Other things being equal a high speed motor is cheaper to build than a low speed one. It is a smaller machine operated at greater activity. If brought to the same speed it would have less power. A motor, to be compared carefully, ought to have these points determined:

1. At what portion of its load does it commence to spark?
2. At what portion of its load will its temperature rise abnormally?
3. What is its efficiency at various points?
4. At what speed does it run?

Reduce all these things to a common basis and you have a fair method of comparing motors.

Too much importance has heretofore been attached to full load efficiencies. Motor engineers boast that their machines have 90 per cent efficiency and some other maker's machines have only 88 per cent efficiency. They speak of the highest efficiency that the machine is capable of, or of the efficiency of which they are most proud. Now that may not be the efficiency which the customer wants to know. There are many cases where a motor of 85 per cent efficiency would take less current to run a printing office than a motor of 90 per cent efficiency, for this reason: At point D, Fig. 1 is a motor of 90 per cent efficiency. But the printing office runs at only about one-third of the power of its motor, and would, therefore, realize the efficiency at B; whereas at point E there is a motor which has 85 per cent efficiency and if the printer bought that he would realize the efficiency at A which is much higher than that at B.

The next feature to which I wish to call your attention is the most recent methods of winding. I cannot go into this more than slightly, but it might be well to give some idea of what they are. In winding bi-polar machines, windings are all on the same principle; they are two-circuit. As the current leaves the brush, in diagram A, Fig. 2,* half goes down one side of the armature and half down the other and joins the bottom brush and goes out. Now there is not much room for modifications in that winding. It can be made ring or drum, and that is practically all. But when we come to the multi-polar machines there is a great variety of windings which we can use. If we imagine B, Fig. 2, to be a four-pole machine, with an armature a ring in which the wire is wound around and around, then the current may be taken off this armature by brushes P. N. P. N. These are the field

FIG. 3.

* From "The Practical Management of Dynamos and Motors," by F. B. Crocker and S. S. Wheeler.

magnets of alternate polarity and each field magnet generates a portion of the total current. This is called four-circuit, because there are four circuits from which the current is collected in the armature.

The earliest multi-polar machines were wound in this fashion, but there are some objections to it. If one pole is stronger than its neighbor, then when it sends its current to be collected it will be under greater pressure than the one coming from the other pole, and if there is sufficient difference will neutralize it and send a reversed current through its winding. This causes heating, diminishes output and reduces the efficiency of the machine. Now it is very easy for one magnet to become weaker than another one in an actual machine. Suppose, for instance, that the bearings of the machine wear. The armature will settle down and will be nearer these bottom magnets than it will be to the top, and they will make stronger currents than the top ones will. Then again, if the windings on the magnets are not very carefully made and one has a few more turns of wire than the other, it will be stronger, and there are a great many ways that the effect of inequality of electro-motive forces generated under the poles will produce very bad results.

To overcome this, windings were invented which are called two-circuit windings. The object of the two-circuit winding is that the wire shown in D, Fig. 2, instead of going along always under the weak pole between every section, cuts across and goes under a strong pole and comes back, and the winding under the strong pole cuts across every other section to the weak, so that by the time the brush is reached the windings have each had acting upon them both the weak and the strong poles, and the result has been to make equal electro-motive forces and produce no trouble.

In actual winding these connections are not made on the armature in this form of two-circuit winding, but are made inside the commutator. This commutator is of the kind shown in Fig. 3. Every bar is connected to the bar directly opposite to it by a bird wing form of connector. The connector is shaped in the following way: It starts down, goes over in the form of a bird wing, goes inside about an inch and after it has reached the under layer of windings it makes the rest of its circuit until it gets down to the bottom. The armature is wound the same as a four-circuit armature, but when its ends are put into the commutators, these cross connectors have the effect of making the alternate poles generate part of the electro-motive force, as shown in the diagram. The armature I have described is but one kind of a two-circuit armature, but there are other kinds that are used just about as much. The other kind of armature is not wound in ring form, but is like that shown at E in Fig. 2. Now the armature I have just described was wound as a coil, which was connected to another on the other side. There will be no short circuiting due to unequal voltages. (A model of this kind of an armature was exhibited.) I will not describe further the two-circuit windings, since they are all on the same principle.

There is another advantage in the two-circuit winding besides stopping the interaction of parts of the armature against itself, and that is that for very high voltage machines, if we had a four-circuit armature as previously described in B, Fig. 2, the wire under each pole would have to generate full voltage. In a 500 volt machine each pole would have to generate 500 volts, so that the little current it contributed would be at the same pressure as the other current. That necessitates fine wire. If there are only two circuits each pole contributes only half the voltage and the wire may be of twice the size, which is a very important consideration. When we get into very large machines, however, then the wire gets too big for us to handle in two-circuit machines and we go back to the four-circuit windings.

The next form of winding that I wish to describe is one in use by the

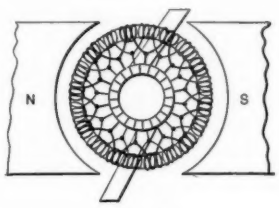


FIG. 4.

General Electric Company and known as a double winding. The reason for a double winding is this: It is a rule among electricians that the voltage between any two bars of the commutator must not be greater than, say, 20 volts. If it is much greater in a large machine any little accident—a piece of carbon—would make a flash, and, once started, the whole commutator would blaze and there would be a short circuit and great trouble. To keep that down the voltage between the bars must be kept down low.

The voltage generated by a machine is proportional to the size of the magnets and the number of the windings. Now as the magnets get large the windings need be fewer in order to generate the same voltage. As our machines get larger and our magnets get larger we only need a few turns of the heavy conductors on the armature to give us, say, 110 volts for lighting. We soon reach the point where, say, 10 turns on the armature would be enough to give us 110 volts. That would give us 10 sections to our commutator, and as half the sections are on one side and half on the other, that would give us only five sections of the commutator among which to distribute 110 volts and that would be more than our limit. Now what are we to do? We cannot increase the number of turns because we would get more voltage than we wanted. We cannot decrease the size of the magnets because then we would have sparking and armature reaction and other

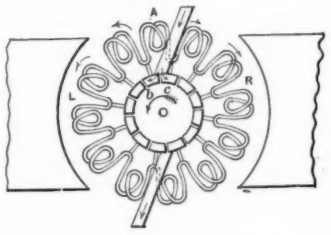


FIG. 5.

troubles. There are two things for us to do; one is to use the multi-polar machines, which have a number of small magnets, each contributing to the total current, or to use the form of winding shown in Fig. 4. Now in this diagram there are 10 coils and 10 commutator bars belonging to each winding. When we use the windings in conjunction we have the voltage due to 10 coils and the commutator bars due to 20, and that is achieved in this manner: The windings are wound just as if they belonged to two different machines. One winding is entirely disconnected from the other and it generates, say, its 110 volts with its few commutator bars—too few to be used by itself. The other winding is entirely separate and it generates its 110 volts with few commutator bars—too few to be used by itself. But when we put these two windings together, then we have still 110 volts, but we have double the current, because each of the windings contributes some, and we have double the number of commutator bars. Now that is in reality just like two dynamos. The brushes are made so wide that they cover at least two of the commutator bars, so that each winding is free to contribute its share of the current, no matter what the position of the armature is. We have shown this for a bi-polar machine. But if we go into multi-polar machines we will soon reach a size where we are again face to face with it, and we would have to increase our poles and would soon catch up with this difficulty again, and this method of double winding is an excellent one for overcoming it. It has also the advantage that the collection at the brush is better.

The next feature I wish to speak about is sparking and armature reaction. Sparking is the phenomenon of sparks at the brushes of a direct current machine due to the self-induction of the coils. There are a number of forms of sparking which are not due to that at all. If this commutator were full of ridges it would spark; but those can be easily

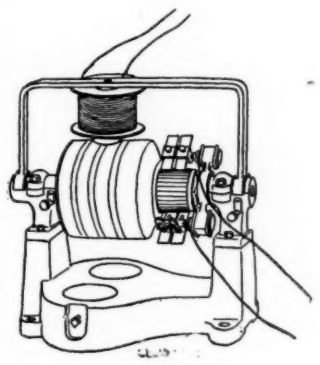


FIG. 6.

turned off. If the brushes are too small it will spark; but they can be made larger. These are not inherent difficulties; they are merely matters of construction. But if we construct these at our best, we will always have the sparking which I have just defined, due to the self-induction of the coils. The reason for that you are familiar with. It is shown in the diagram, Fig. 5. It is at the moment of change of the direction of the current that we get the spark, the same as we do in an induction coil when we start or stop a current in it; and this coil has a certain amount of electrical inertia that it will not submit to being reversed suddenly. It has got to take a little time and the spark shows. Now a large portion of the design of direct current machinery is nothing else than the provision that the machines shall not spark. There are two methods by which we can stop the sparking. The first method is by forced commutation. The second method is by means of an electro-motive force applied to the coil which is at the moment having its current changed. This electro-motive force helps it to change quickly. Forced commutation is the means of killing the spark by resistance of brushes. The coil A, Fig. 5, has no current in it. But as the armature is revolved pretty soon the toe of the brush will leave the commutator bar *b*. Then the brush will bear only upon the commutator bar *c*. Thus half the current will be obliged to go through the coil A in order to get through that half of the winding marked L, and the other half will come down to R as usual. Now if that coil A can be prepared so that when its turn comes to take its place with the rest of the winding it can have the current already flowing in it of the same quantity as the current in its new position, then, on leaving the toe of the brush, at that bar B there will be no sparking. Now that can be done in forced commutation by having the resistance of the brush sufficiently high. As the commutator moves and the brush touches less and less of the bar *b*, the current finds it harder to get into this commutator bar than into *c*, so it begins to overcome the electrical inertia and go up the coil A gradually from *c*. By the time *b* has moved from under the brush the whole current will have been gradually throttled to go out of the bar *b* and forced to go up into the coil A, and there will be no sparking.

To put carbon on some machines is very bad, because it has so very much higher resistance than copper that it uses up the power of the machine, and therefore other materials have been very much sought for. The copper brush is made many laminæ so that the current that comes down through the brush cannot all get squeezed into that little toe. It cannot get into that toe unless it is started into it at the top of the brush, and if it is started into it at the top there is an appreciable resistance. If that resistance is not enough we resort to the copper gauze brush, which has a much higher resistance than a copper leaf brush, and while there are some mechanical advantages in using it, such as cooling effects, yet the principal reason it stops sparking is that it has higher resistance. If this is not high resistance enough we go the next step, which is a brass gauze brush having about twice the resistance of copper gauze. If that is not enough we take the next step. That is some form of carbon which has its resistance reduced. Ordinary carbon cannot have its resistance reduced. But all sorts of inventions have been made, such as putting fine filings in the brush, and in this case the brushes are made with layers of gauze molded in them, so that the gauze helps to increase the conductivity of the brush. After that comes the pure carbon, and if that is not of high enough resistance it can be made as high as desired by mixing clay with it. The resistance of brushes ought to go up as the voltage of the machine goes up. I have had in mind, but have not had the time to carry them out, experiments to determine just what the law is. I believe it should go up as the square of the voltage, and that by making our machines on that basis and considering the resistance of the brushes just as much a part of the design as we do the resistance of the armature windings, we could build very large machines of very high voltage without sparking. I do not see why the resistances could not be just right so as to squeeze all of a 10,000 volt current over into the bar following before the break takes place.

In connection with this there is one thing that we have forgotten. If we do that squeezing and throttling, it heats the commutator, and if the commutator is too small its temperature rises. It decomposes the carbon brush; it gets black and the machine is rendered unfit for use. If you are going to determine on forced commutation you must then have a definite ratio of commutator surface for every horse-power in your machine. That is as true as the fact that the resistance of your brushes should go up with your voltage.

(To be continued.)

THE TELEPHONE DOOR: A STUDY OF TELEPHONE TRAFFIC IN EXCHANGES AND FOR INDIVIDUALS.

BY ANGUS S. HIBBARD IN "ELECTRICAL ENGINEERING."

The records which have been made of telephone traffic during the past year have brought out two important truths: First, that a knowledge of the number and character of calls handled by each exchange is of constant value in determining the character and extent of the plant which will best transmit them; and, second, that a like knowledge of the calls of the individual telephone subscriber is of great value to him in determining what is necessary for his telephone service.

In an earlier paper I have endeavored to show some of the results found in the records made in various telephone exchanges of the calls received and handled during a business day. In these records the rise and fall of business transactions in the various cities during the hours of the day and night are clearly indicated in the curve of originating telephone calls, the busiest point being found at about 10 o'clock in the morning, falling away to the minimum, which is reached at about 3 o'clock A. M.

The large telephone exchanges show in a general way parallel lines of telephone traffic, rising quickly to a maximum after 9 o'clock in the morning, falling away at noon to a day minimum at 12.30 P. M., rising again in a broad afternoon sweep to a maximum at about 3 o'clock, and quickly dropping after 4 or 5 o'clock has passed.

Some interesting comparisons may be made by examining the records of the telephone exchanges in Chicago, New York, Boston, St. Louis and in a few other cities. In all of these exchanges the business morning, as indicated by the telephone calls, is about one hour shorter than the business afternoon. This is especially true in Chicago and Boston. The length of the period during which business matters, as represented by telephone calls, fall away at the lunch hour is shown in an interesting manner. A number of the records of the New York exchange seem to indicate that there the lunch period is about two hours long, in Chicago about one hour, and in Boston and St. Louis, in some instances, less than half an hour. The records of Chicago show relatively a very much larger number of telephone transactions during an afternoon than those of any other exchange, and it is probably due to this long busy afternoon record that the average use of the telephone in Chicago is found to be larger than that in any other city at the present time. One of the latest records of this exchange shows that on a Saturday, which happened to be stormy, 153,807 telephone calls were made by the subscribers during the day, meaning that double that number, or 307,614 people, talked over the telephones during that time. In one hour 19,500 calls were originated. Out of the above total 83,007 were trunked from one exchange to another, making a total of 236,814 calls handled by the telephone operators in Chicago during that day. On the following Monday, the afternoon being about one hour or one hour and a half longer than the Saturday, the total, no doubt, would have been increased by 20,000 calls. No record, however, was made on the Monday in question.

The record made of the traffic of various exchanges has led, during the past year, to another record which has been of interest, more especially to the users of telephones. This is a traffic record of the subscriber's telephone, showing just how many times it is used each day on outward calls and on inward calls, and how many times the line has been called for by others and found busy, showing also whether the "busy" calls were on account of the fact that the telephone was being used for outgoing or incoming business. In the Chicago exchange the records of about 3,000 lines have been kept in this manner. The lines which were known to be used to the greatest extent were first made of record, and the showing for a number of them has been found most interesting and instructive. In one case a firm of packers, having six lines connected with the Yards exchange in Chicago, was found to use the telephone an average of 802 times in each day. It was found, also, that this firm was called for many times when all the lines were busy. The matter of this telephone traffic was taken up with the people in charge of this part of the firm's business, and it was found that frequently all of their telephones, or nearly all of them, were engaged by their own men at one time in making outward calls. It was shown that the telephone lines represented business entrances, or doors for business to the firm's office, just as much, in a way as the actual doors leading from the street or hallway, and, in fact, more so, because more people procured an entrance through their telephone doors—if I may use that term—than in any other way. It was then shown that if these telephones were blocked by the outgoing work of the firm's employés, it was naturally impossible for anyone desiring to do so to get in at the same time. In a way, it was as if, in a large retail store, at the same time it was opened for business in the morning, an order should be given to the shipping departments to ship the goods out of the front doors, filling them with boxes, trucks and men. This, it is evident, would immediately paralyze the retail business, because no one desiring to trade with the firm could gain admission through the usual entrances. Such a proceeding would naturally drive away the custom and very much interfere with the business of the retail store. This point being illustrated, it was arranged with the firm of packers that they should not allow their own people to use all of the telephones simultaneously, but endeavor, in every way, to leave at least one line open and available for the entrance of calls to their offices. This simple arrangement, which was merely an appreciation by the subscriber of what the telephones really could do, led to an immediate relief in the traffic. The 800 and more calls were handled as before, and the number of busy or unavailing calls was largely reduced. The record of the traffic shown and illustrated in this manner, without the addition of other telephones, but merely by bringing about a co-operation and better use of existing facilities by the subscriber, resulted not only in great benefit to him, but in the convenience of his customers. In other cases it was found that where a single telephone was used one hundred or more times in a day the busy or unavailing calls for the line were very largely caused by the habit of the subscriber in originating a large number of calls consecutively, and in that way blocking out, during a period often of one hour or more, all of the calls which had been made for his line. People who wanted to talk with the subscriber were knocking at his telephone door, finding it busy again and again, and finally, in very many instances, gave it up entirely or took their business to someone else. The door, meanwhile, had been locked by the voluntary action of the subscriber himself, just as much as if he had locked the door of entrance into his place of business and refused admission to all parties.

This record of telephone traffic upon the subscriber's lines is showing clearly every day that the final completion of a telephone call depends not wholly upon the telephone company or its agents, but very largely, and in many cases almost wholly, upon the intelligent use of the telephone by the subscriber.

In looking at the telephone as a door or entrance for business, which it certainly is, the user must understand that if his business is extensive in volume it can no more enter by one door or one telephone, which is limited in the extent to which it can be used, than it is possible for an extensive trade represented by customers to enter by one narrow door. There must be doors enough, and there must be telephones enough and people enough employed to handle the telephones to accommodate the business and the trade which enter in that way.

This condition of things has been appreciated to an extent perhaps greater in the Chicago exchange than in any other. Very many of the larger business firms are furnished with auxiliary telephones used under the same name and number as that which is found in the published directory. All of these are used in common and as a means of reaching the point which has been advertised.

In a number of instances where these auxiliary lines are furnished it has been put upon the telephone company in order to clear its decks of busy calls, to watch the lines of the subscriber to ascertain that the telephones were properly manned, so that when calls were put upon auxiliary lines they would be answered with reasonable promptness by the desired parties. Here, again, the co-operation of the subscriber is necessary to the success of his own telephone traffic. One instance is of record in which a member of a firm having three telephones made a complaint to the effect that he never was able to use one of them. Being asked to explain just how this happened in his case, he replied that he would watch one of his telephones until it was disengaged by his own people from the work of receiving calls and orders, and would then start toward it to make his call. Before reaching it, however, the bell would ring again, and the line blocked by a customer of his who had called for him. In other words, the inward traffic over the three lines was monopolizing them to such an extent that it was almost impossible for him to send an outgoing call during the busy hours. If originating calls had been made over these lines they would, during the busy hours, have blocked incoming work. An arrangement was finally made by which a fourth telephone was put in which was not made auxiliary to the others, and which was used only for outgoing calls. This relieved the pressure in this especial case, and undoubtedly will until the volume of incoming business requires additional facilities. In a number of instances the blocking of business by the subscribers was found to have been caused by the unwarranted and unnecessary use of the telephones by employés, the "deadly office boy" once again figuring as an especial stumbling block. In other cases the blocking was found to be occasioned by the habit, when a call was received, of instructing the calling party to "hold to the line," whereupon the clerk who answered the telephone would hunt around for the individual called for, and perhaps at the end of five minutes or more bring him to the telephone. During this period of time perhaps 25 other correspondents desiring to talk either with the subscriber originating the call or with the office at which instructions had been given to "hold the wire," were entirely blocked out. They had been knocking at the two telephone doors, but found them blocked in this foolish way. It is impossible to make a general rule, or to advise in one general way in regard to the needs of all telephone subscribers. There are a few suggestions, however, which will undoubtedly apply to all:

If the inward business is of any value—that is, if it is of any value to you to receive calls—do not block them out and make it impossible for them to get to you by originating a lot of calls consecutively; by "holding your wire" or allowing anybody else to hold it, which merely means to tie it up and make it unavailable during long periods.

Answer the telephone just as promptly as possible.

If the party wanted is not near the telephone or is not in the office so that he may be called at most within a minute, get the number and name of the party calling and say that the person who has been called for will be informed and will call up as soon as possible.

Watch the use of the telephone so that it may be restricted to your business needs.

Your line, during a long business day, may be made to satisfactorily handle perhaps 80 calls if they are evenly distributed. If, however, your telephone work is congested into three or four hours, it is not possible to handle any such number on one telephone.

If one telephone is not enough to accommodate your business, use two or more. If this arrangement is not profitable, it would be well to instruct correspondents whose business is not of importance to avoid calling you by telephone.

Such an analysis of the traffic will be of benefit to every busy telephone subscriber, and his own action in relieving the pressure on his line will benefit him more and enhance the value of his telephone more than anything he can do.

To-day the telephone exchange is a great and important factor in the transaction of business in large cities. It is no longer a matter of one line to an exchange or one instrument in an office or warehouse; it is a means of doing business which must be fitted to the business itself—not to the business of the telephone company, but to the business of the telephone user. It must be made extensive enough and broad enough to meet his uses and demands, and it must be used by him in a way in which it will best meet these demands. It is being shown throughout the country that the telephone exchanges do and will adapt themselves to the needs of the business of their patrons. Telephones are now being furnished in large exchanges to accommodate the lightest and most infrequent user as well as the heaviest, in one case a single instrument, in the other possibly a large private branch exchange operated by the subscriber. The determining quantity is the telephone traffic which the subscriber wishes to handle. On it depends the number and kind of telephone "doors" necessary for his exits and entrances. An appreciation of the facts of telephone traffic by telephone users will thus be of immediate benefit to them and to their correspondents. It will make the telephone door swing more easily and more frequently, and not often be found in that unsatisfactory condition, "Busy now, please call again."

Electric Lights and Power in Boston's State House Extension.

A FINE ISOLATED PLANT.

By far the finest isolated power plant anywhere in this section of the country is that of the new State House extension, which is fast nearing completion. The building itself is well worthy of mention, and no expense or labor is being spared in any detail of its construction. It is built of iron, marble, terra cotta and stone, finished throughout in oak and mahogany, and is as nearly absolutely fireproof as it is possible to get it. The interior fittings and decorations are very fine, and the electrical equipment is fully in keeping with the rest of the construction. The engine and dynamo room is located in the subbasement, in a room 90x36 feet, having a concrete floor and walls and massive supporting pillars of white enameled brick. It is lighted by 60 incandescent lamps arranged in groups of two in ornamental side brackets, and presents a remarkably attractive appearance. The electrical plant consists of four units, each of which comprises a McIntosh & Seymour tandem compound high speed engine of 180 horse-power, direct connected to two General Electric multipolar 50 kilowatt dynamos of 900 lights capacity. The engines and dynamos are run at 275 revolutions, and when all in operation the plant has a capacity of nearly 800 horse-power and over 7,000 lights. The switchboard, which is not yet completed, will be a massive affair 22x19 feet, and containing every possible device for handling and controlling the many different circuits. By means of this switchboard the engineer will have complete control of the lights in every room and hallway in the entire building and can operate them separately or as a whole.

All the wiring is concealed, being carried from the dynamos to the switchboard in conduits under the floor, and from there throughout the building in brass covered conduits, manufactured by the Interior Conduit Company. Every wire is accessible and can be easily removed, if necessary. The boiler room contains four Babcock & Wilcox boilers of 208 horse-power each, fitted with Roney mechanical stokers. Coal is brought from the bunkers to the boilers in tram cars running on rails set into the concrete floor. Over each dynamo is a traveling crane for handling any parts necessary for repairs, etc. The building is heated and ventilated by a system of fans and blowers driven by C. & C. and Crocker-Wheeler motors. Taken as a whole, the plant is a model one in every respect, and already several contracts for electrical equipment have been secured on the strength of the showing made. Through the courtesy of Chas. A. Legg, chief engineer, the writer was favored with an opportunity of going over the plant, and is indebted to him and to J. E. Monroe, foreman for the General Electric Company, for information obtained.

Boston Trolley Cars Need Heaters.

Many of the suburban patrons of the West End company are loudly complaining of the discomfort they experience through riding to and from their homes in unheated cars, and are threatening to withdraw their patronage unless something is done to alleviate their discomfort and lessen the danger of sickness to which they are now exposed. That their demands are reasonable anyone who has been forced to spend from 45 minutes to an hour in one of their traveling refrigerators will gladly testify, but it is probable that nothing short of a marked falling off in travel will have any effect in bringing about the desired result. The threadbare argument that heated cars are detrimental to health on account of the life infused into possible and impossible quantities and qualities of microbes, which may be secreted in the cushions, is a rather weak attempt to dodge the issue of expense, which is the true and only reason for not properly heating the cars. There are plenty of good heaters in the market, electrical and otherwise, whose merits have been demonstrated, but they cost money, and as long as the public will submit to do without them, just so long they will be allowed to revel in this privilege. As to the microbes, a man whose feet are like blocks of ice, and down whose neck an icy blast is getting in its work, will gladly take all chances in regard to them for the sake of a little comfort and to escape that most deadly of all microbes, pneumonia, to which at present he is extending a hearty invitation to "come and see him." Cars can be warm and at the same time properly ventilated, and it rests with the public themselves whether or not it shall be done. H. G. T.

An expired electric railway franchise in Somerset, Mass., is a bone of contention over the possession of which there promises to be quite a struggle. Several parties are after it.

VENTILATING SUBWAY MANHOLES BY SEWER CONNECTIONS.

SUCCESS OF THE METHOD ADOPTED BY THE NATIONAL CONDUIT MANUFACTURING COMPANY.

To the Editor of Electrical Review:

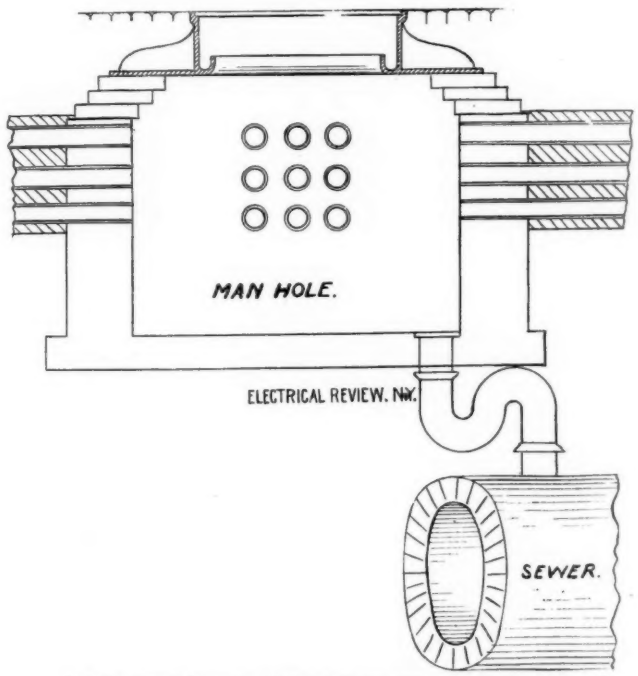
Since the explosions during the past two weeks in the subway manholes in Brooklyn, Boston, Rochester and Philadelphia, there has been more or less talk among electrical men as to the best way to remedy this trouble. We have built during the past five years subway systems in the different cities in the United States containing nearly 10,000 manholes. In our street railway work in Chicago, in Philadelphia and in Boston, in every instance where we were above the sewer, we made a connection to the sewer with a trap as is shown in the accompanying sketch.

We have not a single instance where there has been an explosion in any manhole in which this connection was made. In Chicago in addition to this connection every manhole cover is ventilated, the same as a sewer manhole cover. There have been positively no explosions of any description in any manholes in this country that have been connected to the sewer and the manhole cover ventilated. The explosions that have occurred have been in manholes that were neither connected to the sewer nor the cover perforated, so as to permit ventilation. This would naturally cause the remark that those manholes will fill with dirt, but from experience the dirt that has accumulated in a month in a manhole in the heart of the business district of Chicago has been removed in 10 to 15 minutes time by two men. The explosions that occurred in Brooklyn not only caused a serious inconvenience and expense by the destruction of the manhole, but also broke the conduit, which was terra cotta, for a very considerable distance from each end.

The explosions in Philadelphia occurred in a conduit system built of wood. This, in addition to destroying the manhole, caused the conduit to catch fire and it was burned some distance from each end. Fortunately for the companies involved, there were no cables in either of these places. Had there been cables the expense would have been very much greater. I claim that very probably both of these explosions would have been avoided had the manholes been trapped to the sewer and the covers ventilated. Certainly the destruction of the conduit would not have occurred if some other form of conduit had been used. There was an explosion at the corner of Thirteenth and Ridge avenues, in Philadelphia, at the main manhole of the Philadelphia Traction Company's conduit system, and the only damage done was that the manhole covers were lifted and thrown across the street. The conduit system, which is cement lined pipe, showed nothing more than a slight blackening on the sides of the conduit. This manhole, from the fact of its being a very large one, having 270 ducts coming into it from the four sides, necessarily made the bottom of it considerably below the sewer, so that it was impossible to connect this manhole to the sewer. All manholes of the Philadelphia Traction Company, more than 4,000 in number, are trapped to the sewer wherever it is possible to do so. They get ventilation in Philadelphia not from the cover being perforated, but from a feed pole, which connects with every third manhole and gives as good, if not better, ventilation than a perforated cover.

The Chicago Telephone Company, of Chicago, were the first company in this country to connect their manholes to the sewer and ventilate the covers. We understand that they have never had an explosion in any of their manholes built according to this plan. They have been in use since 1888, and some of them are in streets where the escape of illuminating gas is so much that it is almost noticeable through the paved streets.

Very truly yours,
Jas. P. McQuaide,
National Conduit Manufacturing Company.
New York, December 5.



Ventilating Subway Manholes by Sewer Connections.

How They Ventilate and Drain Subways in Rochester, N. Y.

To the Editor of Electrical Review:

In regard to your remarks regarding subway explosions, we would state that the Rochester Gas and Electric Company have 358,000 feet of ducts in use on five and one-quarter miles of street with 151 manholes. We have tried stand pipe ventilation and find we have better success by using perforated covers to the manholes. We are now changing covers to the latter style. In all our manholes we have trap drains into the main sewers; therefore, we are not bothered with water in our manholes. Very truly,

G. A. Redman,
Rochester Gas and Electric Co.
Rochester, N. Y., Dec. 3, 1894.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 2339. NEW YORK.

EDITOR:
CHARLES W. PRICE.

ASSOCIATE EDITOR:
STEPHEN L. COLES.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.

1546 "CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
H. G. TUCKERMAN, Room 29, 620 Atlantic Ave.
WASHINGTON OFFICE:
GEO. C. MAYNARD, 800 H St., N. W.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy, - - - - - - - .10
Back Copies, each, - - - - - - .25

NEW YORK, DEC. 12, 1894.

CONTENTS.

	PAGE
Views, News and Interviews	287
The American Bell Telephone Company's Mining Telephone Set	287
Direct Current Motor and Dynamo Design	288
The Telephone Door; A Study of Telephone Traffic in Exchanges and for Individuals	290
Electric Lights and Power in Boston State House Extension	291
Boston Trolley Cars Need Heaters	291
Ventilating Subway Manholes by Sewer Connections	291
How They Ventilate and Drain Subways in Rochester, N. Y.	291
Wall Street and the Electrical Stock Market	292
A Powerful Storage Battery Combination	293
Cored Carbons	293
The Electro-Metallurgy of Gold and Silver	294
New York Electrical Society	295
A Roller-Expanded Rail Bond	295
Amendment of New York Fire Underwriters' Rules	295
Arc Lamps in Cotton Mills	295
The Electric Mining Plant at Oroville, Cal	296
Death of Fred. W. Degenhardt	296
Electric Power for the Manhattan Elevated Railways	296
Further Developments in that Big New Jersey Traction Deal	296
General Notes	296
Electric Railway Notes	296
Suburban Traction Company, of Orange, N. J., in a Receiver's Hands	296
Personal	296
Telephone News and Comment	297
Electric Light Flashes	297
The Intelligent Stenographer and "Compli-cators."	297
Kindred Interests	298
The Poetry of Motion	298
Electrical Patents	ix
Electric Traction in Egypt	ix
Advance Information	x

INDEX OF ADVERTISERS.

COVER PAGES.

	PAGE
Abendroth & Root Mfg. Co., boilers	xvi
American Electrical Works, insulated wire	i
Ansonia Brass & Copper Co., wire	xvi
Armington & Sims, engines	xvi
Beacon Vacuum Pump and Electrical Co., incandescent lamps	i
Bunnell & Co., J. H., dry batteries	i
Campbell Electrical Supply Co., incandescent lamps	i
Day's Kerite, insulated wire	i
Eastern Electric Cable Co., insulated wire	xvi
Eddy Electric Mfg. Co., motors	i
Fort Wayne Electric Corporation, new "Wood" transformers	ii
Goubert Manufacturing Co., heaters	xvi
Hammond Cleat and Insulator Co., waterproof sockets	i
Hampson & Co., E. P., engines	xvi
Helios Electric Co., arc lamps	xiv, xv
McKenney & Waterbury, lamps and fixtures	i
New Haven Car Register Co., fare registers	xv
Okonite Co., insulated wire	i, xvi
Partridge Carbon Company, motor and generator brushes	i
Rhode Island Tool Co	xvi
Stirling Co., water tube boilers	xvi
Weston Engine Co., engines	i

INSIDE PAGES.

	PAGE
Accumulator Co., storage batteries	v
American Bell Telephone Co	iv
American Carbon Co., carbons	viii
American Watch Tool Co., bench lathes	xiv
Ashcroft Mfg. Co., gauges	xiv
Baker & Co., platinum	xiii
Barthel Torch Co	ix
Belden Machine Co., drop forging	298
Belknap Motor Co., woven wire brushes	298
Berlin Iron Bridge Co., iron roofs and buildings	xiii
Bernstein Electric Co., incandescent lamps	xi
Billings & Spencer Co., commutator bars	xiv
Bishop Gutta Percha Co., wires and cables	xi
Bradbury-Stone Battery Co	ix
Brill, J. G., Co., railway cars	xi
Brown & Sharpe Mfg. Co., machinery and tools	xiv
Brush Electric Co., arc lamps	iv
Buckeye Electric Co., incandescent lamps	viii
Buffalo Engineering Co	xiv
Case, J. T., Engine Co., engines	xi
Central Electric Co., electrical railway supplies	iii
Challen, Howard, record books	298
Chapin, Chas. E., R. Thomas & Sons, porcelain	xiv
Clonbrock Steam Boiler Works, steam generators	iv
Colgate Company, Geo. L., pole paint	297
Consolidated Electric Storage Co., batteries	ix
Correspondence School of Sciences	x
Cutter Electrical and Mfg. Co	xiv
Dixon, Jos., Crucible Co., belt dressing	iv
Dunderdale, C. F., telephone and switchboards	x
Duval, Edward S., Jr., patents	ix
Electrical and Mechanical Engineering and Trading Co	iv
Electric Construction and Supply Co., lamps	ix
Empire China Works, porcelain specialties	iv
Falls Rivet & Machine Co., friction clutches	v
Faraday Carbon Co., carbons	xii
Faries Manufacturing Co., electric light holder	x
Garvin Machine Co., machine tools	xi
General Electric Co., the monocyclic system	vii
Globe Iron Roofing and Corrugating Co	iv
Harrisburg Foundry & Machine Works, engines	v
Hart & Hegeman Mfg. Co., snap switches	xiv
Hill, W. S., Electric Co	iii
Hornberger Electric Co., Elkhart transformers	v
Huebel & Manger, bells, push buttons, etc	xiv
Interior Conduit and Insulation Co., Lundell dynamos and motors	xiv
Keasbey & Mattison Co., magnesia sectional coverings	viii
Knabe, Wm. & Co., pianos	298
Lane & Bodley, street railway engines	v
La Roche Electrical Works, generators and motors	xiv
Leclanché Battery Co., batteries	xiv
Leffel, Jas., & Co., water wheels	xii
Lehigh Valley Creosoting Co., creosoted lumber	297
Manning, Maxwell & Moore, tools and supplies	xiv
Marshall, Wm., condensers	xi
Mather Electric Co., power generators	x
Metropolitan Electric Co	vii
Metropolitan Telephone and Telegraph Co	297
Moore, Alfred F., insulated electric wire	xiii
Mutual Life Insurance Co	298
National Conduit Mfg. Co	xiii
National Telephone Mfg. Co	iii
New England Engineering Co	iii
New York Belting and Packing Co., rubber belts	xii
New York & New England R. R	v
New York & Ohio Co., Packard lamps	xi
Ostrander & Co., W. R., supplies	298
Oxford Mfg. Co., sewing machines	xi
Palmer Bros., telephones	297
Partrick & Carter Co., electrical supplies for housework	x
Penberthy Injector Co	xiv
Perkins Electric Switch Mfg. Co., switches and sockets	xiv
Phillips Insulated Wire Co., wire	viii
Phœnix Carbon Mfg. Co., carbon specialties	ix
Riker Electric Motor Co	xiv
Robinson & Orr, steel rails	xi
Royce & Marean, electrical supplies	298
Safety Car Heating and Lighting Co., Pintsch gas lighting system	297
Schieren & Co., Chas. A., leather belting	298
Schoonmaker, A. O., India mica	xiv
Self-Winding Clock Co., clocks	xiv
Smith, Jas., Woolen Machinery Co	xiv
Solar Carbon and Mfg. Co., carbon specialties	xiv
Splitdorf, C. F., spark coils	iv
Standard Paint Co., insulating compounds	viii
Stevens, H. L. C., photo-engraving	iv
Thompson & Bushnell Co	xiv
Varley Duplex Magnet Co., magnets	x
Western Electric Co., supplies	iv
Western Telephone Construction Co., telephones	iv
Westinghouse Electric & Manufacturing Co., multiphase motors and generators	xii
Weston Electrical Instrument Co., measuring instruments	viii
White-Crosby Co., contracting engineers	297
Whitney Electrical Instrument Co., ammeters and voltmeters	xii
Wilkinson, W. H., automatic wiping device	298
Williamsport Wooden Pipe Co., creosoted conduits	xiv
Wyckoff Pipe Co., inc., creosoted tubing	ii

At last it seems probable that the management of New York's elevated railways intends to adopt electric power and improve the service generally. That vote at the last election in favor of a rapid transit road seems to have already borne fruit.

Last week a New Yorker wrote to the *Sun* that Mr. Edison has on his front door an electric bell which does not work. The shoemaker's son always goes barefoot.

Every progressive electric light man will be interested in the interview relating to carbons, which appears elsewhere in this issue. There is no more important element than the cost and quality of carbons connected with the business of electric lighting.

We congratulate our esteemed contemporary, *Power*, on attaining its tenth birthday. The occasion was celebrated by making its December number a special issue of unusual interest and practical value. Steam engineers have a stalwart champion and wise mentor in *Power*.

Mr. Gano S. Dunn's lecture on "Direct Current Motor and Dynamo Design," recently delivered before the New York Electrical Society, is full of practical interest for the student and the dynamo tender, as well as the designer of electrical machinery. The first installment of the lecture appears in this issue of the ELECTRICAL REVIEW.

Our recent request for opinions as to the proper ventilation of subway manholes has brought out two opinions from practical men which appear on another page. Our columns are still open to a discussion of this matter and we shall be pleased to receive any further remarks on the subject. Another manhole explosion occurred at Twenty-ninth street and Sixth avenue, New York city, last Friday, in which two employés of a gas company were injured. Had the manhole been properly ventilated there would have been no accumulation of gas and, consequently, no explosion. Has Major Kearney, of the Subway Board, any remarks to make?

The encouraging reports now emanating from electrical manufacturing companies lead us to hope for decidedly brighter times after the first of January. One large manufacturing company reports that its plant is in operation 24 hours per day and several others are running time and a half. The wire companies are all busy, which is a good indication that plenty of new construction work will be commenced when the weather permits. The principal car manufacturers are doing a good business, although prices rule lower than last year. Where the climate is favorable track construction is progressing rapidly. Taken altogether the signs are propitious and the wise man will plan his campaign so as to be in at the finish when the new business is placed.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

The common stock of the American Sugar Refining Company monopolized the attention of Stock Exchange speculators nearly all the week. During the first three days the market was irregular with a strong undertone, and in the closing days, under a stimulus afforded by the decision of the Democratic Senators to drop the popgun legislation, and the more tangible shape of the railway pooling clause in the House of Representatives, a covering movement set in which continued up to Friday night, advancing prices all through the list. In the last hour on Saturday a moderate reaction occurred. Leading bears are out of the market for the moment and every indication points to much higher prices before the first day of January. Underlying conditions are improving steadily, a fact which is most thoroughly indicated by better railroad returns, industrial resumption and a return of confidence. This latter movement has been accelerated by the utterances of President Cleveland, Secretary Carlisle and Comptroller Eckles on currency reform. The shipment of $1,250,000 gold was a regular transaction. Part of the amount went in liquidation of balances created against this country by sales of our stocks. Should that center turn buyer gold exports will stop temporarily, at least.

All the active electrical stocks participated in the advance of the latter days of the week. Those of an inactive character which, by the way, are considerably above the market, did not respond as readily. However, if the movement continues they will undoubtedly establish higher prices.

Of this class General Electric was typical. The lowest price touched was on Monday, being 34½. On Friday and Saturday the prices were higher, the highest price being 36¼ and the closing 35⅝.

I hear very good reports concerning General Electric. The company is working 3,300 to 3,500 at Schenectady and 2,000 men at Lynn. Certain parts of those plants are operated night as well as day. The Yerkes-Chicago street railway contract is in hand and is responsible for this increase in the force. A director of the company informs me that it expects big things from this contract, as the entire Yerkes system has agreed to take all its electrical apparatus from General Electric. Another contract of importance is the one let by the West End Street Railway Company, of Boston, for 110 motors with which to equip 65 cars. This, it is said, was divided equally between General Electric and Westinghouse.

One of the most important deals pending is the electrical equipment of the Manhattan Railway Company of New York city. An officer of General Electric admitted to me this week that the Manhattan company decided some time ago to electrically equip its plant, but as was told in the ELECTRICAL REVIEW, the cost incident to such work was so great as to cause a postponement. Now, in view

of the inroads being made upon traffic by the Metrópolitan Traction Company's cable and transfer systems, the Manhattan is bestirring itself and one of its proposed changes is the substitution of electricity for steam power. The contract, I understand, has not been placed, but that it will be early in the new year is practically certain. General Electric is making a strong fight for the contract, and owing to its influence in financial circles, stands a good show of securing it.

The preferred stock of the company was strong at 70, which is an advance of 3 points over the lowest quotations of last week. The debenture bonds sold at 89 to 89½.

Trustees of the Street Railway Illuminating Property, a company which took over certain collateral assets of the General Electric at the time the latter was in need of money, have purchased and cancelled 444 shares of preferred stock, paying an average price of $105.72 per share, the highest yet paid. This makes 18,139 preferred shares cancelled to date.

As was intimated in this column some weeks ago the Westinghouse directors this week declared a quarterly dividend of 1¾ per cent on the preferred stock, payable January 2 to stockholders of record, December 22. Books close December 22 to January 2, both days inclusive. The quotations of the company's stock weakened slightly during the week, closing 32 bid and 32½ asked for the common, and 50½ bid and 51½ asked for the preferred.

The Western Union statement for the last quarter of the calendar year will be out next week. It will show a decided improvement in earnings over the September quarter, and place to the company's credit a substantial surplus. The stock advanced in sympathy with the market. The collateral trust 5 per cent bonds sold at 108¾ to 109. The debenture 7's had one sale at 111½.

Of the inactive stocks, Edison Electric Illuminating, of New York, was quiet at 99 to 99½. There was more than the usual demand for the first mortgage 5 per cent bonds, the price advancing from 107⅝ to 108. This reflected an investment demand which speaks well for the faith of capitalists in the property. North American sold from 4 to 4⅛. American Telegraph and Cable sold at 99. American Bell Telephone reflected increased strength, advancing one point to 198. Erie Telephone was unchanged at 52; New England Telephone at 66; Fort Wayne Electric 2 to 2½.

The Third Avenue Cable Railroad Company has called a meeting of stockholders for December 26 to vote upon the proposition to increase the capital stock from $7,000,000 to $9,000,000. The proceeds will be used to pay off the company's indebtedness incurred in the construction of the cable. BAIN.

New York, December 8.

The Helena, Mont., Street Car Company wants the council to allow it to raise the fares to 10 cents.

A POWERFUL STORAGE BATTERY COMBINATION.

THE ELECTRIC STORAGE BATTERY COMPANY, OF PHILADELPHIA, HAS ABSORBED SEVERAL OF ITS COMPETITORS AND IS NOW IN CONTROL OF IMPORTANT PATENTS.

A very important consolidation of storage battery interests which has been going on for several weeks has been made public. The Electric Storage Battery Company, of Philadelphia, manufacturers of the well-known Chloride accumulators, have acquired all the rights, patents and licenses of the Consolidated Electric Storage Company, of New York, which include those of the Brush Electric Company, of Cleveland; the battery patents and all interests in connection with batteries and the good-will of the General Electric Company's branch of the business; all property rights and patents of the General Electric Launch Company and the Electric Launch and Navigation Company, both of New York, and the rights, licenses and patents of the Accumulator Company, of Philadelphia.

When the final arrangements in the deal have been consummated it will virtually place the Electric Storage Battery Company in possession of the principal patents on storage batteries in the United States, and will end the litigation which has been going on for years. A large share of the Electric Storage Battery Company's stock is owned by the United Gas Improvement Company, of Philadelphia, and the same people are interested in the management of both, including Thomas Dolan, William G. Warner and W. W. Gibbs, who is president of the Electric Storage Battery Company.

The Electric Storage Battery Company is incorporated under the laws of New Jersey and has filed a notice of increase of capital stock from $10,000,000 to $13,500,000. It is understood that $500,000 of this increase has all been underwritten at $50 per share by a syndicate of well-known financiers. This will provide an additional cash capital for the extension of the business. The market value of the present stock, as noted in the Wall Street column of the ELECTRICAL REVIEW from time to time, has recently risen from $20 to about $40 per share.

As reported in the ELECTRICAL REVIEW for June 14, 1890, the Consolidated Electric Storage Company owns the Julien storage battery patents, including that for the inoxidizable support plate. It also owns the exclusive right to use for the whole of the United States all the Brush storage battery patents and inventions. It had an exclusive license under four patents. These were Nos. 337,29 and 337.398, which are the broad Brush patents covering the mechanical application of any absorptive substance to a conducting support; Nos. 266,090, which covers a conducting support with receptacle for containing material, and 260,654, which covers the application of oxide of lead to the support plate by pressure. The Consolidated company also owned the mechanical filler patents of Morris and Salom. The two first mentioned Brush patents run seven years from May, 1895. The mechanical filler patents have about 11 years of life, and the Julien storage battery patent No. 347,300, for the inoxidizable support plate, has about 10 years to run. It was stated at the time the Consolidated Electric Storage Company was formed, in 1890, that $275,000 in cash had been deposited with a trust company in New York city to secure the various rights and licenses which it acquired. It was rumored last week, however, that the Consolidated company owes the General Electric Company some $60,000, the Brush Electric Company some $15,000, and is obligated to the Atlantic Trust Company for $200,000.

Mr. William Bracken, president of the Consolidated Electric Storage Company, was asked last Thursday by a reporter for the ELECTRICAL REVIEW if he had anything to say on the new combination. He replied: "The deal is far from being consummated, let alone there being any deal. Newspaper reports don't count for everything." Further than this Mr. Bracken did not care to express himself.

It is rumored that two English storage battery companies intend to establish manufactories in America, one of which will make the Tudor battery.

Mr. Gibbs, who is the president of the Electric Storage Battery Company, will, it is understood, remain in that position and will be the directing influence of the company. Mr. Gibbs has proved to be a man of progressive ideas and it is expected that with his newly acquired opportunity of combining the best points of the several batteries mentioned, the accumulator business in the United States will be developed along lines that have heretofore been impossible, owing to impending litigation.

CORED CARBONS.

INTERVIEW WITH A PROMINENT MANUFACTURER IN THIS FIELD.

The carbon business of the United States has attracted much interest of late, and many rumors have been afloat concerning improvements that have been made by the Washington Carbon Company, of Pittsburgh. A representative of the ELECTRICAL REVIEW hearing that Mr. James S. Humbird, who is at the head of this company and a widely known electrical man, was in New York, called on him at the Fifth Avenue Hotel, and asked for the latest news in regard to the carbon business. Mr. Humbird was apparently greatly pleased over the carbon situation, and expressed himself as willing to tell the results of the new work of the Washington company.

"I presume you know," said Mr. Humbird, "that we Americans have been after a home product in the way of a cored carbon to compete in quality with the foreign make. We have been working on such a carbon for the last two or three years. Several times we thought we had it, only to discover that the carbons we had made would not do at all. So we decided to adopt different methods entirely unknown in this country, and in order to do this we were obliged to get new talent and means to make what is now known as the 'Helios' carbon. This new carbon is conceded by all who have tried it to be the best in every way."

"Well, Mr. Humbird, what do you intend to call this new product?" was asked.

"The Helios Electric Company, of Philadelphia, has assigned to us the trade mark and copyright of the word 'Helios' as applied to carbons, and did this because they are progressive people who want the best carbon to be had, and they were well satisfied to put the matter in our hands."

"I understand there is an increasing demand in electric lighting circles for cored carbons, and I would ask what your facilities are for turning them out?"

"I am glad you asked that," said Mr. Humbird; "we have just completed all-iron fireproof buildings as an addition to our works at Washington, Pa., to be devoted to the exclusive manufacture of cored carbons for both direct and alternating currents. This new factory is of sufficient capacity to not only take care of the business in this country, but will enable us to export these goods to Europe, and we are now arranging to establish agencies in Germany and England."

"Do you expect to be able to compete with the foreign manufacturers on their native heath?" the REVIEWITE inquired.

"I think so," was the reply.

"It seems to be the impression that your chief competitors in this country have formed an alliance against you—in fact, organized what is generally known as a 'carbon trust.' What have you to say about this?" was asked.

"Well," replied Mr. Humbird, with a twinkle in his eye, "there does seem to be such an impression. I understand the 'trust' is composed of the Brush company, the National, the Standard, the Fidelity, the Thomson-Houston and Faraday, and further, I understand the Fidelity factory has been closed, and one or two others may follow, concentrating the manufacture at Cleveland, Ohio. The natural result of such a combination would seem to be an advance in the cost of carbons to the consumer, but, if you will permit me say in this interview, the Washington Carbon Company stands in the way of such a scheme. However, the 'trust' is only in the solid carbon business."

"Every electric light manager is interested in the lengthening of the life of carbons, and the ELECTRICAL REVIEW would be pleased to announce the result of your experiments in this direction," said the questioner.

"I presume you mean solid carbons for series arc lighting. I would rather not say much about that to-day, but I can tell you this:

"The Washington company is going to give all the old carbon makers a surprise in the very near future, and I would advise all electric lighting companies to go slow in making their contracts for the ensuing year."

"I have heard reported that prominent New York bankers are behind the Washington Carbon Company, and if not an improper question, would ask if this is true?"

"No; this idea probably grew out of the announcement that I am to be connected with a New York bank as a director, which is the case. The report probably grew out of this."

THE ELECTRO-METALLURGY OF GOLD AND SILVER.

READ BEFORE THE ENGINEERS' CLUB, OF PHILADELPHIA, BY A. L. ELTONHEAD.

I hope the following will be of interest to some of the members of this club and to others who are interested in the utilization of electricity in the cheaper methods of extracting gold and silver from their ores.

Those who are familiar with the cyanide process know of the difficulties one contends with in using zinc shavings or zinc in any other form to precipitate the gold and silver from cyanide solutions; such as the dissolving of the zinc as the solution passes over it, and after a short time rendering the solution inert for the dissolving of gold and silver, which makes necessary the running to waste of large quantities of solution which contain considerable free cyanide of potassium, gold and silver.

There are certain unaccountable reactions that occur which prevent the total precipitation of the precious metals from the solution when using zinc shavings as the precipitant.

Large losses occur in collecting, drying and smelting the resultant "zinc slimes," or precipitate, which we all know is not a homogeneous mass, and great care is necessary in sampling it for assay. The resultant bullion is sold in South Africa for about 10 shillings ($2.40) less per ounce than for the bullion received from the amalgamated plates of the stamp mills.

There has been erected a small plant for working what is known as the electro-chemical process (patent applied for) on the west side mine of the Tombstone Mill and Mining Company, of Tombstone, Arizona.

The process overcomes the above difficulties encountered in precipitation, in which electricity enters as a factor and the resultant precipitate is recovered in the shape of gold and silver amalgam.

Electricity is being utilized more and more every day in chemical and metallurgical operations, and it is not surprising that an important discovery has been recently made, in which it has been found that the precious metals can be precipitated on a large working basis when they are in solution with certain chemicals, such as the cyanides, with the aid of electricity for the electrolysis of certain saturated solutions of the alkaline metals or earths.

A description of the process is as follows: The ore is crushed to a certain fineness, depending on the character of the gangue. It is then placed in leaching vats, with false bottoms for filtration, the same as other leaching plants. A solution of cyanide of potassium and other chemicals of known percentage is run over the pulp and left to stand a certain number of hours, depending on the amount of metal to be extracted. It is then drained off and another charge of the same solution is used, but of less strength, which is also drained. The pulp is now washed with clean water, which leaches all the gold and silver out and leaves the tailings ready for discharge, either in cars or sluiced away by water, if it is plentiful.

The chemical reaction of cyanide of potassium with gold is as follows, according to Elsner:

$$2Au+4KCy+O+H_2O=2KAuCy_2+2KHO$$

That is, a double cyanide of gold and potassium is formed.

All filtered solutions and washings from the leaching vats being saved and passed through a precipitating "box" of novel construction, which may consist either of glass, iron or wood, and made in any shape, either oval, round or rectangular—if the latter, it will be about 10 feet long, four feet wide and one foot high—and is partitioned off into five lengthwise compartments. Under each partition on the inside or bottom of the "box" grooves may be cut a quarter to a half inch deep, extending parallel with the partitions, to serve as a reservoir for the amalgam, and give a rolling motion to the solution as it passes along and through the four compartments. The center compartment is used to hold the lead or other suitable anode and electrolyte.

The anode is supported on a movable frame or bracket, so it may be moved either up or down as desired, it being worked by thumb screws at each end.

The electrolyte may consist of saturated solutions of soluble alkaline metals and earths. The sides or partitions of each compartment dip into the mercury, which must cover the "box" evenly on the bottom to the depth of about a half inch.

Amalgamated copper strips or disks are placed in contact with the mercury and extend above it, to allow the gold and silver solution of cyanide to come in contact.

The electrodes are connected with the dynamo; the anode of lead being positive and the cathode of mercury being negative. The dynamo is started, and a current of high amperage and low voltage is generated, generally 100 to 125 amperes, and with sufficient pressure to decompose the electrolyte between the anode and the cathode.

As the gas is generated at the anode, a commotion is created in the liquid, which brings fresh and saturated solution of electrolyte between the electrodes for electrolysis, and makes it continuous in its action.

The solution of the double cyanide of gold, silver and potassium, which has been drained from the leaching vats, is passed over the mercury in the precipitating "box" when the decomposition of the electrolyte by the electric current is being accomplished, the gold and silver are set free and unite with the mercury, and are also deposited on the plates or disks of copper, forming amalgam, which is collected and made marketable by the well-known and tried methods. The above solution is regenerated with cyanide of potassium by the setting free of the metals in the passage over the "box."

In using this solution again for a fresh charge of pulp, it is reinforced to the desired percentage, or strengthened with cyanide of potassium and other chemicals, and is always in good condition for continuing the operation of dissolving.

The chemical reaction of forming cyanide of potassium in the precipitating "box" is as follows, per Elsner:

$$2K+2H_2O=2KOH+H_2$$
$$2(AuKCy_2)+H_2=2KCy+2HCy+2Au$$
$$2HCy+2KOH=2KCy+2H_2O$$

Which is explained thus: The potassium acting on the water of the solution creates nascent hydrogen and potassium hydrate; the nascent hydrogen sets free the metals (gold and silver), which are precipitated into the mercury and form amalgam, leaving hydrocyanic acid; this latter combines with the potassium hydrate of the former reaction, thus forming cyanide of potassium. There are other reactions for which I have not at present the chemical formulas.

As the solution passes over the mercury the center compartment of the "box" is moved slowly longitudinally, which spreads the mercury, the solution is agitated and comes in perfect contact with the mercury, as well as the amalgamated plates or disks of copper, insuring a perfect precipitation.

It is not always necessary to precipitate all of the gold and silver from the solution, for it is used over and over again indefinitely; but when it is required it can be done perfectly and cheaply in a very short time.

No solution leached from the pulp, containing cyanide of potassium, gold and silver, need be run to waste, which is in itself an enormous saving over the use of zinc shavings when handling large quantities of pulp and solution.

Some of the advantages the electro-chemical process has over other cyanide processes are: Its cleanliness, quickness of action, cheapness, and large saving in cyanide of potassium by regeneration; not wasting the solutions, larger recovery of the gold and silver from the solutions; the cost of recovery less, the loss of gold, silver and cyanide of potassium reduced to a minimum; the use of caustic alkalies in such quantity as may be desired, to keep the cyanide solution from being destroyed by the acidity of the pulp and also sometimes to give warmth, as a warm cyanide solution will dissolve gold and silver quicker than a cold one. These caustic alkalies do not interfere or prevent the perfect precipitation of the metals. The bullion recovered in this process is very fine, while the zinc precipitated bullion is only about 700 fine.

The gold and silver is dissolved and then precipitated in one operation, which we know cannot be done in the "chlorination process;" besides, the cost of plant and treatment is much less in the above-described process.

The electro-chemical process, which I have hastily sketched, will, I think, be the future cheap method of recovering fine or flour gold from our mines and waste tailing or ore dumps.

Without going into details of cost of treatment, I will state that with a plant of a capacity of handling 10,000 tons of pulp per month, the cost should not exceed $2 per ton, but that may be cheapened by labor-saving devices. There being no expensive machinery, a plant could be very cheaply erected wherever necessary.

Sir Humphrey Davy first electro-deposited the metal sodium in the year 1807, and deposited it easily into mercury, forming an amalgam by a crude though effective method. He first made a cup-shaped receptacle of moistened carbonate of soda, placed it upon a platinum plate, the cup was filled with mercury and made the cathode, and the platinum plate the anode; then, with a current of electricity from a powerful battery, the metal sodium was deposited into the mercury, thus forming an amalgam. Also, in the year 1837, in the Philosophical Transactions of the Royal Society, it is stated that Dr. Golding Bird, in 1837, decomposed, by means of a voltaic current, solutions of the chlorides of sodium, potassium and ammonium, depositing their respective metals on a negative pole of mercury, and thus obtained their amalgams.

It has been traced back to the year 1840, that Mr. John Wright dissolved gold and silver in cyanide of potassium solutions successfully. A patent was taken out March 25, 1840, by Messrs. G. R. and H. Elkington, of London, who incorporated in their patent the above discovery of Mr. Wright, for the use of soluble alkaline cyanides in any strength solutions required for dissolving metallic gold, silver or any other metal; also any compound of these metals in a finely divided condition, such as a chloride precipitate, etc. The use of cyanide of potassium, or any of the soluble alkaline earths, for dissolving metals, has become public property since the expiration of the above patent of Messrs. Elkington.

I call attention specially to the above facts, to show that the ideas of using electricity for the making of alkaline metal amalgams, and the use of cyanide of potassium in particular for dissolving metals, were both well known years ago.

In the year 1837 electro-metallurgy was brought into prominence by the many experiments made upon the deposition of different metals; but it was not until recent years that the ideas then advanced were put into practical shape and successful operation. Modern mechanical devices and the powerful electric dynamo have made possible the rapid strides in electro-metallurgy.

In the electro-chemical process, which I have described above, the ideas of Sir Humphrey Davy and Mr. John Wright have been utilized to a certain extent in making sodium and potassium amalgams by the electric current, and the dissolving of metals with the cyanides; but the construction of the precipitating "box" used in the described process, whereby the gold and silver only may be extracted perfectly from an old plating solution of cyanide, or from a cyanide solution leached from gold and silver ores, is new.

It is well known to chemists that the silver of an old cyanide-plating solution cannot be satisfactorily converted into pure chloride by adding an excess of hydrochloric acid, and boiling the mixture; the precipitate so obtained is of different colors and contains foreign substances; while, with the electro-chemical process, the gold and silver only were precipitated, as was clearly shown by the assay of the resultant bullion, which was 990 fine. The cyanide solution tested contained large percentages of copper, lead, zinc and iron, with small percentages of manganese, carbonate of lime, etc., which were left in the solution, not being precipitated with the gold and silver. Surely, a more severe test could not have been taken for the demonstration of the advantages of the process.

It may be suggested, since the above metals were in combination, as the double cyanide with potassium and sodium, that the gold and silver are electro-negative to hydrogenium-potassium, or hydrogenium-sodium amalgams, depending on the electrolyte decomposed. Water requires about 1.5 volts to decompose it by an electric current; caustic soda requires over two volts, yet if mercury is present to absorb the sodium as it is set free and protect it from the water, we shall obtain sodium amalgam, while the water is decomposed, at the same time forming hydrogenium amalgam. These amalgams thus formed in the precipitating "box" coming into contact with the solution of the double cyanide of gold and silver, aid the setting of them (gold and silver) free, the mercury immediately absorbs them and forms the amalgam, which is easily collected, retorted and smelted into bullion. There may be other theories advanced by those more familiar with the subject, but the results obtained are more than flattering.

In examining the recovered gold and silver amalgam after a "clean-up," there were discovered through it hard lumps or nodules, some crystalline in form, having a bright metallic appearance, different from the surrounding mass. I would be pleased to know if anyone can give an explanation of the formation of

the above forms, as it presents a curious phenomenon.

The above process will be worked by the Electro-Chemical Reduction Company on a large scale in different gold and silver bearing countries.

The process is not adapted to all refractory ores. Some need a previous treatment, as was the case with ores tested from the Lucky Cuss mine, at Tombstone, Arizona. The ore contained silver, gold and about 35 per cent of manganese. By the simple process of leaching only three per cent of the bullion was recovered; but by first roasting with 10 per cent of common salt, and then by the electro-chemical process, over 92 per cent of the bullion was extracted. Fuel is a great factor to be taken into consideration. At Tombstone wood costs, delivered, nine dollars per cord, which makes it out of the question to treat their low grade manganese ores. In other localities, where gold is found in a finely divided or flour condition, the cost of working this process is the cheapest known, taking into consideration the amount of bullion recovered.

In the chlorination process, if 95 per cent is recovered from the concentrates, containing, say, six ounces of gold, there is lost 0.3 ounces, or six pennyweights, in the tailings. In the electro-chemical process pulp containing but 0.5 ounces gold is treated, and 85 per cent or more of the assay value is recovered; and there is lost about 0.075 ounces, or 1.5 pennyweights, of gold in the tailings. The advantage of the latter process is obvious, even if the cost of treatment were the same, which is not the case.

The possibilities of the electro-chemical process are unlimited, as the precipitating "box" may be used to extract gold and silver from the ores direct, or from other solutions than the above mentioned cyanides.

New York Electrical Society.

The New York Electrical Society was organized in 1881 "for the advancement of electrical knowledge and the study of electrical and other scientific phenomena." That this purpose has been effectively carried out is shown by the fact that the society's list of members now numbers 350, and is rapidly increasing.

It has been found advisable to extend the scope of the society by supplementing the regular course of lectures and papers with a series of "visiting meetings," at which the members are enabled to see practical illustrations of work in the leading branches of electrical application. These meetings have been highly successful, and will in future form a regular feature of the season's arrangements.

The society's programme for the remainder of the season of 1894-95 is as follows:

Lecture on "Some Leading Phenomena and Principles of the Alternating Current," by Mr. C. S. Bradley.

Lecture on "The Production of the Higher Forms of Carbon (Such as Carborundum, Diamonds, etc.) by Electricity," by Mr. E. G. Acheson.

Visit to the Metropolitan Art Gallery and Museum, with a lecture on "Interior Lighting," by Mr. Luther Stieringer.

"Niagara on Tap: A Lecture on the Details of the Water Power of Niagara," by Mr. T. C. Martin. The lecture will be illustrated by lantern slides made from photographs taken specially for the lecture.

Lecture on "The Doctrine of Unity in Electricity," by Dr. Michael I. Pupin.

Visit to an electric lighting station.

Talk on "Street Railway Practice in the United States," by Mr. C. B. Fairchild. The lecture will be based on personal observation in a trip across the country and through the South, and profusely illustrated by lantern slides.

Lecture on the "Use of the Electric Light in Lantern Projections," by Mr. E. L. Hopkins. In this lecture the incandescent light and the arc light will be shown on the screen under varying conditions, and the voltmeter and the ammeter will also be visible, so that their readings can be followed with all the changes in the power of the light.

Lecture on "The Static Machine and its Use and Office in Electro-therapy," by Dr. W. J. Morton.

A Roller-Expanded Rail Bond.

Mr. F. Foley Robinson, an English engineer, has devised a novel rail bond, shown in the accompanying illustration, which is taken from our London namesake. It is understood that Mr. Robinson has applied for a patent in respect of the terminals, which consist of short metal tubes expanded into the webs of rails in the usual manner employed by boiler-makers to secure tubes in tube plates. This method is claimed to possess the following advantages: 1. Cheapness, as ordinary wrought iron tube may be used, sawn into short lengths, and oxide removed by grinding or otherwise. Thus no turning or expensive machining is required. 2. Large and efficient contact area, the surfaces of holes and tubes being quite bright. Mr. Yarrow has proved by experiment that the holding power of a two inch tube, expanded in the ordinary way, is at least eight tons, and that the effect of "rolling" is not merely to bring the two surfaces in contact, but to cause pressure one against the other.

Amendment of New York Fire Underwriters' Rules.

At a meeting of the New York Board of Fire Underwriters held on November 27, 1894, the following amendment to the rules and requirements of the Board for the installation of electric light and power was adopted:

Rule 22. INTERIOR CONDUITS—Add to clause *e*: "Unless the said two separate conductors or twin conductor having an improved insulation are enclosed in a complete, fully insulated, continuous iron conduit, and are in circuits installed as per table of capacity of wires (see Section 25), for currents not to exceed 100 amperes."

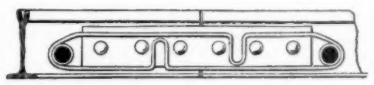
As amended, Rule 22 reads as follows:

e. Must not be supplied with a twin conductor or two separate conductors, in a single tube, unless the said two separate conductors or twin conductor having an approved insulation are enclosed in a complete, fully insulated, continuous iron conduit, and are in circuits installed as per table of capacity of wires (see Section 25), for currents not to exceed 100 amperes.

Arc Lamps in Cotton Mills.

The use of arc lamps in cotton mills, upon what is known as the "inverted arc system" of lighting, is slowly but surely making headway in England, says the London *Electrical Review*. Owing to the murky atmosphere which prevails in our manufacturing districts, where cotton mills most do congregate, and where the sun is rarely seen, there is need for artificial light during the greater portion of the working hours, hence the question of lighting is a very important one, not only for mill owners but also for mill hands. Gas at its best is a poor substitute for daylight, and is further objectionable on sanitary grounds. The advent of incandescent electric lighting was a great improvement, no doubt, both as regards safety and health, but it still left much to be desired as a light for mill purposes. Arc lighting, as then known, was found unsuitable on account of the hard shadows cast, and furthermore was regarded as unsafe, and consequently practically prohibited by the fire offices.

The first attempt at mill lighting by arc lamps upon a rational system emanated, if we mistake not, in France. This simply consisted in suspending an inverted cone reflector



A ROLLER-EXPANDED RAIL BOND.

below the arc, thus throwing the light first upon the whitened ceiling above and thence upon the work below. By thus doubly reflecting the light, and at the same time shielding the eye from the direct rays, the effect was most pleasing, the perfect diffusion thus attained practically destroying all shadow. The next advance was to invert the arc itself by placing the crater carbon below, and in this form we have what is known as the "inverted arc" system of lighting. So much is the new light appreciated—rivaling daylight itself—that mill owners readily pay the extra tax imposed by the fire offices rather than be without it. At the same time it must be admitted that great care is needed when introducing arc lamps in the presence of such highly inflammable material as cotton, and upon this score we venture to offer a few remarks.

There are two cases on record of serious fires in cotton mills traceable to arc lighting. In the first case the usual netted glass globe had alone been relied upon for protection, and, owing to some imperfect construction, or, what is more likely, the neglect of the trimmer to replace an injured globe, a particle of heated carbon escaped from the lamp on to the material below, immediately setting fire to the cotton, and resulting in the destruction of the mill. The second case was in connection with the use of an inverted cone reflector suspended below the arc by means of chains, made detachable to admit of trimming. The lamp had just been retrimmed when the cone reflector was seen to tilt violently on one side, dislodging a large particle of the crater carbon on to the mule beneath, setting fire to the cotton, with the same disastrous result to the mill as in the case above quoted. Here again, the trimmer either failed to properly reconnect the chain or else some part of the suspension gear gave way. Now there is a lesson to be learned from these two fires. It is evident that glass, or any other such brittle material should not alone be relied upon as a guard against the escape of heated material from the arc. The necessity for retrimming every six or eight hours during the running of the mill, and frequently under trying circumstances, leads to breakages, which are not always attended to in time; and the bungling or neglect of the trimmer is the one factor most to be feared, as well as the most difficult to provide for. Glass of any kind is, therefore, better dispensed with. It absorbs much light, particularly when coated with dust, and casts unpleasant shadows. The supposition that there is danger in a naked arc burning in an atmosphere charged with fine cotton flyings has been proved groundless, and experiments also show that the dust which collects within the reflector is impotent to do harm. In fact, it appears that the one and only danger to be apprehended is the possibility of a considerable particle of the incandescent carbon coming in contact with the material itself. We believe it possible to give all the protection necessary by a well designed and ample metal inverted cone reflector, without the addition of a globe, provided it be permanently and rigidly attached to the body of the lamp. Indeed, it should be a *sine quâ non* in all arc lamps for cotton mill lighting that no essential guard nor any part of the suspension gear need detaching for purposes of adjusting or renewing carbons.

Next in importance is the suspension gear; for should a lamp fall when in use, the result would probably be fatal. Usually the lamp is suspended by a cord or chain, with counterweights, over a couple of small pulley wheels, with considerable wear and tear upon the cord. This, therefore, should be strong, preferably of steel, with well made connections; and as an additional precaution, an independent guard chain is recommended, to prevent the lamp falling beyond a certain distance, in the event of any portion of the suspension gear giving way.

The use of arc lamps in the spinning and carding rooms of cotton and flax mills must always be attended with more or less danger, and only by carefully attending to such details of construction, as we have here briefly alluded to, can that danger be reduced to a minimum.

It is reported from London that a light railway may be built between Beaumaris, Anglesea, and Llanfairpwllgwyngyl. The cars will have to be extra strong to carry such a name as that. They must be longer than usual, too, or the name will trail out over the end and tear up the track.

The Electric Mining Plant at Oroville, Cal.

An interesting electric mining installation has been in operation for sometime past near Oroville, Butte County, Cal., at the Banner mine of the Development Syndicate, Major Frank McLaughlin, general manager. The particular interest applying to this installation is due to the fact that all the power required for both the mining and the milling of the ore is electric. The power station is about two miles distant from the mine and mill, and water is obtained from the Feather River, under 112 feet head, operating two Pelton water wheels, which in turn drive two 85 horsepower direct current 500 volt generators.

The power applied by the generators is utilized in driving motors operating separately a 10 stamp gold mill, a rock breaker, a 10 by 20 inch Rand air compressor and two pumps on the 300 and 500 feet levels of the mine, of the Knowles' vertical triplex single-acting type, one with plungers of six and one-half inch diameter by eight inch stroke, and the other of the same type with plunger of five inch diameter by six inch stroke. The hoisting works are also operated by an electric motor, and the mine and mill lighted from the power wires. Owing to lack of water for power the hoist has thus far only been operated intermittently, but a large bulkhead has been recently built, which will store sufficient water to allow of its operation at all times in connection with the other apparatus.

The following letter attests the success attending the operation of this plant :

DEVELOPMENT SYNDICATE, LIMITED.

OROVILLE, CAL., October 26, 1894.

Thomas Addison, Esq.,
Manager General Electric Company,
San Francisco, Cal.

MY DEAR SIR: I take great pleasure in stating that the electric power plant installed by your company at the Banner mine, for operating the mill, rock-breaker, lighting system, air compressor and the pumps on the 300 and 500 levels, works perfectly and to our entire satisfaction.

I take advantage at this opportunity to acknowledge with thanks the constant courtesy, vigilance and ability of your representatives, and to congratulate both you and them on the successful installation of the electric plant in the face of natural obstacles and mechanical difficulties that were seemingly insurmountable.

FRANK MCLAUGHLIN, Manager.

Death of Fred. W. Degenhardt.

Fred. W. Degenhardt, Chicago manager for the Standard Underground Cable Company, of Pittsburgh, died at Chicago of pneumonia at noon on December 7. He was ill but a short time. Mr. Degenhardt was one of the most popular members of the electrical fraternity and had an unusually large acquaintance among electrical men.

Ex-Governor Oden Bowie died on December 4 of paralysis at Bowie, Md. He was 68 years old and a prominent figure of Maryland. He was Governor of the State from 1867 to 1871, and since that time had continuously been president of the Baltimore and Potomac Railroad Company and of the Baltimore City Passenger Railroad Company.

Electric Power For the Manhattan Elevated Railways.

Last week it was announced in Wall street that the Manhattan Elevated Railway Company was again seriously considering the adoption of electric power on its roads in New York city. There was also a story current that the roads would be double decked and that these improvements would be started within six months.

A director of the General Electric Company was quoted as saying that his company has been figuring for some time on a contract for the Manhattan Elevated which calls for the equipment of some 257 motor cars and erection of power plants.

It was also reported that conferences have been held between Wm. C. Whitney, John D. Crimmins and Chas. R. Henderson, of the Metropolitan Street Railroad system, and Geo. Gould, J. P. Morgan and Russell Sage, of the Manhattan Elevated, looking toward a consolidation of the cable and elevated roads.

Further Developments in That Big New Jersey Traction Deal.

Another step in the big traction deal at Trenton, N. J., which was reported in last week's ELECTRICAL REVIEW, was taken on December 7 when the Trenton Traction Company filed articles of incorporation. The capital is to be $500,000, consisting of 10,000 shares, of which Thomas C. Barr, of East Orange, holds 4,000 shares; Edward J. Moore, of Philadelphia, 4,000; George B. Jenkinson, of Newark, 200; Fred W. Roebling, of Trenton, 200; John L. Kuser, Trenton, 800; Hugh H. Hamill, Trenton, 200; and Francis M. Eppley, West Orange, 200. The company is organized to control the Trenton electric railway lines and form a connecting link in the line between New York and Philadelphia. At meetings of the stockholders and directors of the Trenton company all the stockholders and directors favored leasing their lines to the new company except Samuel K. Wilson, who owns one-third of its stock and is a heavy endorser. He insists that the new organization assume $80,000 of notes given, on which he is an endorser, and also assume $80,000 of floating indebtedness. Because of Mr. Wilson's stand further negotiations will be necessary. If his objections can be overcome the injunction proceedings now before the Chancellor will be discontinued and the lease effected.

GENERAL NOTES.

The Eastern Electric Cable Company, of Boston, has secured an injunction restraining the American Loan and Trust Company from disposing of $100,000 worth of bonds held under an agreement relative to the Great Western Manufacturing Company, whose failure was announced in the ELECTRICAL REVIEW last week.

At a meeting of the New York Board of Electrical Control last week, when the application of the Special Fire Alarm Signal Company for a franchise came up for consideration, the president of the company, Mr. Pierce, acknowledged that the company had been doing business for 12 years without a franchise. No final action was taken on the application.

ELECTRIC RAILWAY NOTES.

The Syracuse, N. Y., Common Council has passed the resolution granting right of way to the Syracuse Street Railroad Company on Walnut avenue over the veto of the Mayor.

Judge Shiras, of the United States Court, has appointed John R. Balch receiver for the Dubuque, Ia., Electric Light and Traction Company, on the petition of the Old Colony Trust Company, of Boston.

The number of 30 foot rail lengths passed over in 20 seconds will give the speed of a trolley car in miles per hour approximately. The rails can be counted by noting the ticks made by the wheels passing over the joints.

The Traverse City, Peninsula and Old Mission Electric Railway Company, with a capital stock of $160,000, has been incorporated. The company proposes to build a standard gauge electric railroad from Traverse City, Mich., to Old Mission, a distance of about 20 miles, and equip the road with both freight and passenger cars.

The City Council of Depere, Wis., has granted a franchise for an electric street railway connecting with the Green Bay system to James H. Elmore and Frank Van Derzee, upon the condition that the railroad shall cross the river on a bridge of the railway company's own construction and run to the Chicago and Northwestern depot.

The Cincinnati Street Railway Company will erect new car barns on the site of their old frame building on Depot street, near Eighth. The new structure will adjoin the power house recently erected. The barn will have a frontage of 120 and a depth of 200 feet. Brick and iron will be used in the construction. The building will be two stories in height and cost $13,000.

The New York Rapid Transit Commission on December 4 received from the Board of County Canvassers a certified copy of the vote cast at the last election upon the matter of municipal construction of a rapid transit system. According to this report there were 184,035 votes cast upon this matter, 132,647 in favor of it, 42,916 against it, 399 defective and 8,073 blank. According to the law, work must be begun by the Commission within 30 days from the time of receiving this report, but just what has to be done to comply with this requirement seems to be a misty uncertainty.

The Aldermanic Committee appointed on November 9 to investigate the alleged $20,000 trolley deal in connection with the granting of the electric railway franchise at New Brunswick, N. J., reports that it had been proved conclusively that no member of the present or past boards had ever received any fee or reward of any kind for favoring or opposing the granting of an electric franchise, and that no demand had ever been made for a consideration of any sort whatever. The board was completely exonerated by the report of the committee. No reference was made to the allegations made against Judge J. K. Rice or M. F. Ross, son of ex-Congressman Miles Ross, as they are not members of the Board of Aldermen.

Suburban Traction Company, of Orange, N. J., In a Receiver's Hands.

Upon the application of the American Loan and Trust Company, of Boston, Watson Whittlesey, of Orange, N. J., has been appointed receiver of the Suburban Traction Company of that city. Vice Chancellor Van Fleet also granted an injunction restraining various creditors from selling at sheriff's sale any portion of the company's assets in executing judgments secured by them. This action caused a stay of proceedings and sale set down for December 7.

The American Loan and Trust Company holds $1,500,000 of 30 year bonds, executed in its favor by the traction company.

The receiver has qualified in $30,000 bonds and has already taken charge of the affairs of the company. It appears that the $1,500,000 bonds were executed on June 1, 1893, and interest at five per cent was to be paid in June and December each year. These payments have not been made until the arrears now are estimated at $22,000. Taxes amounting to $6,000 have not yet been paid, and the concern owes $140,954.56 of floating debt. The company's commercial paper is falling due almost daily and there are no funds to meet these obligations.

The company's resources are estimated at $500,000. This includes 10 miles of track, two-thirds of which is electrically equipped, 18 cars, 30 horses, one and a half acres of land, known as Glenwood Park, a power house and other equipment of the street railway company. Frank W. Child is the company's president and Albert W. Kissam its secretary.

PERSONAL.

Mr. C. J. H. Woodbury, of the American Bell Telephone Company's Boston staff, was in New York last week.

Col. George L. Beetle, of the Western Electric Company, Chicago, arrived in New York last week and will be here for a short time.

Mr. Henry Hine, general manager of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., was in New York city last week. Mr. Hine says that his company is very busy and is running its factory 24 hours per day.

Mr. Russell B. Harrison, of the Terre Haute, Ind., Street Railway Company, which recently received a city lighting contract at Terre Haute, has purchased five of the Western Electric Company's 100 light arc machines and 400 arc lamps.

Mr. James W. Godfrey has resigned his position as general manager of the New York Insulated Wire Company, 15 Cortlandt street, New York city. Mr. Frank R. Harrington has also resigned his position as general sales agent of the same company. Both these gentlemen have a wide acquaintance in the electrical field, and their many friends will be glad to learn that they will still be identified with the industry. Mr. Godfrey is especially well known to consumers of wire all over the United States.

TELEPHONE NEWS AND COMMENT.

Several improvements in the telephone service are being carried out at Milwaukee, Wis.

The Citizens' Mutual Telephone Company, of Lockport, N. Y., has forwarded its incorporation papers to Albany. The 90 days given the Bell Telephone Company in which to remove their poles from the streets expired last Sunday.

The use of the telephone on Australian sheep ranches is becoming common. Its employment is mentioned on the Clark ranch in Montana, where all the sheep and shepherds are watched and handled telephonically by means of six stations all communicating with a central point, from which come weather signals, orders, etc.

The Southern New England Telephone Company is about to lay a cable under the Connecticut River at Essex to Lord's Cove hill, Conn., one and a half miles in length. This will probably do away with the old cable at Ely's ferry crossing on the river, one mile above, as well as with the many telephone poles on the ferry road.

The first public test in the United States of a new long distance telephone, by L. T. Erishon, of Stockholm, Sweden, over the wires of the Postal Telegraph Company between Memphis, Tenn., and Birmingham, Ala., a distance of 285 miles, was made on December 2. The test is reported to have been successful.

There really doesn't seem to be any good reason why the telegraph, telephone and electric railway companies should be compelled to cut their wires at their own expense every time a building is moved through the streets, says a St. Paul paper. The streets are not intended to be occupied by moving buildings. Those who wish to use them for such a purpose are trespassers on the rights of the public, and should pay all the damages caused thereby, whether to private individuals or to corporations. On the other hand, when it becomes necessary to cut these wires for any public purpose, as in case of fire, the companies should do it at their own expense, for the rights of the public are paramount.

ELECTRIC LIGHT FLASHES.

The city of Bayfield, Wis., purchased the electric light and waterworks at that place on December 1.

Trumansburg, N. Y., wants electric lights. The contract for lighting at that place has expired and the question of electric lights is being agitated.

The Moorestown, N. J., Electric Light Company has issued a notice to its patrons to the effect that after January 1 the price of light would be increased 25 per cent.

The Edison Company at Spokane, Wash., offer to supply the city with 201 arc lights burning all night for $7 a month, or 125 lights burning till midnight at $7 a month, and 25 lights burning all night at $10 a month.

The citizens of Parkesburg, Pa., held a special election last week at which they voted on the advisability of raising the tax rate for the purpose of having the borough illuminated by electricity. Electricity carried the day by a vote of 189 to 32, or 6 to 1.

The conference committee of the Allegheny, Pa., councils has reported in favor of awarding the contract for the city lighting plant to the Westinghouse Electric and Manufacturing Company. The Western Electric Company is the lowest bidder for the plant and will endeavor to secure the contract.

A dispatch from Tacoma, Wash., dated December 6, says that C. B. Wright, of Philadelphia, has been made defendant in a suit instituted by the city of Tacoma, in which it is alleged $100,000 was expended in bribing voters to vote in favor of the purchase of a light and water plant for $1,750,000, which the city officers claim is worth much less than this amount. Mr. Wright was interested in the plant.

The Intelligent Stenographer and "Complicators."

TO THE EDITOR OF ELECTRICAL REVIEW:

Your note a couple of weeks ago of the intelligent printer who got "slow tension" for low tension is a parallel to the case of the intelligent stenographer who reported a technical discussion held in this town some 18 months ago. One of the speakers had much to say about the evils inseparable from commutators. Our stenographer friend got the word "complicators," and so transcribed it in his notes throughout the discussion. "He builded better than he knew." Yours truly,

ALEX. DOW.

Detroit, December 5, 1894.

A new electric road has been incorporated in Fall River with a capital of $50,000, all of which is subscribed. J. F. Shove has been elected treasurer and the board of directors is composed of well-known local capitalists.

Telephone Equipment Wanted.

We are in the market for the material for and construction of a telephone exchange for from 50 to 100 'phones and will require from 10 to 20 miles of wire.

CITIZENS' TELEPHONE CO.,
Mt. Pleasant, Penn.

The Metropolitan Telephone Company, 18 Cortlandt St., offers New York City Exchange service at $80 per year upward, according to use, Metallic Circuit Line; Full Long Distance Equipment.

WHITE-CROSBY COMPANY,
CONTRACTING ENGINEERS,
EQUITABLE BUILDING, BALTIMORE, MD.
New York Office, 29 Broadway.
Chicago Office, The Rookery.

ALL KINDS PRICES OF PARTS Dynamos and Motors AND PARTS OF SAME TELEPHONES ELECTRICAL SUPPLIES
SEND STAMP FOR CATALOGUE PALMER BROS. MIANUS, CONN.

THE LEHIGH VALLEY
CREOSOTING CO.
WORKS, PERTH AMBOY, N. J.
Office, Rooms 136 and 137, 1 Broadway, NEW YORK.
Creosoted Lumber, Underground Conduits. Telegraph Poles, Piling and Ties Furnished.

POLE PAINT.
The most economical pole paint is the McINTOSH.
Will outlast anything in the market. Write for prices.
GEO. L. COLGATE COMPANY, Manufacturers,
136 Liberty Street, New York.

JUST OUT.
A SPLENDID BOOK FOR
STREET RAILWAY MEN.
256 PAGES. Price $1.00. POSTAGE PREPAID.
Electric Railway Motors:
THEIR
CONSTRUCTION, OPERATION AND MAINTENANCE.
AN ELEMENTARY PRACTICAL HANDBOOK FOR THOSE ENGAGED IN THE MANAGEMENT AND OPERATION OF ELECTRIC RAILWAY APPARATUS.
RULES AND INSTRUCTIONS FOR MOTORMEN.
By NELSON W. PERRY, E. M.
Address, ELECTRICAL REVIEW,
13 PARK ROW,
P. O. Box, 2339. NEW YORK.

THE PINTSCH GAS LIGHTING SYSTEM

Has been adopted as the STANDARD LIGHT by the Broadway and Third Avenue Cable Lines, of New York City; the North and West Chicago Cable Lines, and the Columbus Central Electric Line, of Columbus, O., also by sixty of the most prominent railways and by the Pullman and Wagner Palace Car Companies in the United States.

It has been the standard lighting system in Europe for many years, and is applied to 55,000 cars in Europe, the United States, South America, India and Australia.

For particulars, address

THE SAFETY CAR HEATING AND LIGHTING COMPANY,
160 Broadway, New York.

KINDRED INTERESTS

A telephone directory of the State of California for December, 1894, has just been received from the Pacific Telephone and Telegraph Company, San Francisco. It is a model of convenience and good arrangement.

The special holiday goods offered by the Electric Construction and Supply Company, 18 Cortlandt street, New York city, are arc light carbons, imported and domestic, "Ward" arc lamps and arc lamps for any incandescent service.

The directors of the Westinghouse Electric and Manufacturing Company have declared a quarterly dividend of one and three-quarter per cent on the preferred stock, payable January 2 to stockholders of record December 22. Books close December 23 to January 2, both days inclusive.

The Eureka Tempered Copper Company, North East, Pa., have issued an illustrated pocket catalogue of their tempered copper products for electrical and mechanical purposes. Mr. John C. Dolph, 126 Liberty street, New York city, is the general eastern agent for this company.

The receiver informs the ELECTRICAL REVIEW that there is an excellent prospect of a speedy adjustment of the affairs of Queen & Company, Philadelphia. Meanwhile their large stock has suffered little diminution and is being kept up in all departments, orders being filled as usual.

"Do you paint your poles?" is the pertinent heading of a little leaflet issued by the Geo. L. Colgate Company, 136 Liberty street, New York, setting forth the merits of the McIntosh pole paints. The same company issues a little book describing and illustrating the Climax iron-clad rheostats and other specialties.

A Chicago branch office has been opened in the Columbus Memorial building by the Self-Winding Clock Company, of 26 Broadway, New York city. The new office will be under the management of Mr. J. W. Forsinger, and a full line of samples will be on display. The western trade, which has been quick to recognize the merits of the Self-Winding Clock Company's products, will undoubtedly find the Chicago office a great convenience.

WOVEN WIRE BRUSHES.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

THE POETRY OF MOTION.

REPRESENTED BY THE NEW YORK CENTRAL.

Speed and comfort are two conditions demanded by modern travelers; but the perfect combination is a rare one. On most American railroads high speed is only possible at the expense of danger and discomfort. To combine comfort and safety with the greatest speed, perfect equipment and absence of sharp curves are necessary. The most perfect roadbed and the most excellent rolling stock will not secure comfort on a railroad that winds sharply among hills, for passengers must inevitably be shaken and jolted about by the sudden changes of direction.

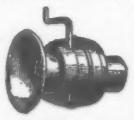
There is only one railroad in America that combines all the conditions essential to the highest speed and the greatest comfort. That is the New York Central and Hudson River Railroad. It holds the world's championship for long distance fast trains, won by recent improvements in equipment and locomotive building that fairly mark an epoch in railroading; and its 100 ton engines, borne on massive rails weighing 120 pounds per yard, now skim with perfect safety around curves at the rate of 90 miles an hour. The solidest of roadbeds is needed to withstand this marvelous speed, and to bear the enormous locomotives and trains; and the New York Central stands alone in the speed of its trains, because what it does with safety is impossible to other railroads of inferior equipment.

But ordinary travelers do not wish exceptional speed when it entails great discomfort; nor is it desirable to court the fatigue and soreness inseparable from a long journey on a jerky train. A journey on the New York Central is the perfection of luxury. It entails neither fatigue nor soreness, for it has practically no sharp curves and its trains move at the highest speed without the slightest shock. Its trains are superb in their furnishings, every detail of modern luxury is provided, the service is ideal. To travel on the New York Central is the poetry of motion. —*The Dry Goods Chronicle.*

CHALLEN'S CONTRACT and ORDER RECORDS. Adapted to any Business or Profession; ruled with printed headings, and indexed through to require the least possible writing to enter data and refer quickly to any name, and save time and money. 5,000 used and reordered. All kinds of Labor-Saving Records on hand or made to order.

CHALLEN, Publisher,
165 Broadway, New York.

W. R. OSTRANDER & CO.
No. 204 FULTON ST., NEW YORK.
Manufacturers of
SPEAKING TUBES, WHISTLES, ANNUNCIATORS.
Electric and Mechanical Bells.
FACTORY,
De Kalb Ave.,
BROOKLYN.
Send for Illustrated Catalogue.



ROYCE & MAREAN,
DEALERS IN
Electrical Supplies,
WASHINGTON, D. C.

Sight Feed Oil Cups.
AUTOMATIC "WIPING DEVICE"
For oiling Crank and Cross-head Pins.
WM. H. WILKINSON,
352 Atlantic Ave., Boston, Mass.

THE BARTHEL TORCH.

The only torch which does away absolutely with the air pump.
This torch can be run at an expense of less than 15 cents per year for repairs.
It gives a steady flame, creates its own pressure, and, in fact, is the only article of this kind now offered which is made on strictly scientific principles.
Sample sent to any part of the United States for $4.00 each. Liberal discount to the trade.

BARTHEL TORCH CO.,
113 DEVONSHIRE ST.,
BOSTON.

KNABE PIANOS

EUGENE D'ALBERT: From the fullest conviction I declare them to be the **best Instruments of America.**

DR. HANS VON BULOW: I declare them **the absolutely best in America.**

ALFRED GRÜNFELD: I consider them **the best Instruments of our Times.**

P. TSCHAIKOWSKY: Combines with great volume of Tone a rare sympathetic and noble Tone Color and perfect action.

WAREROOMS:
No. 148 FIFTH AVENUE, NEW YORK,
NEAR TWENTIETH STREET.

BALTIMORE: 22 and 24 E. Baltimore St.
WASHINGTON: 817 Pennsylvania Ave.

BEST FOR ALL Electrical Work

PATENT PERFORATED ELECTRIC LEATHER BELTING

CHARLES A. SCHIEREN & CO.,
Patentees and Sole Manufacturers.

47 Ferry Street, New York.
226 No. Third Street, Phila.
46 So. Canal Street, Chicago
119 High Street, Boston.

A Suggestion That Everyone Should Heed.

Put your savings in an investment exempt from fluctuation in value and beyond the reach of commercial disaster.

There are no receiverships, reorganizations or repudiations possible in the promise to pay of the *Mutual Life Insurance Company.*

The income of the Mutual last year was $41,953,145.68; its outstanding insurance $708,692,552.40, and its assets $186,707,680.14.

Every desirable form of policy is issued by the Mutual Life Insurance Company.

For particulars, address
WALTER H. COOKE,
32 Liberty Street,
NEW YORK CITY